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Civil Engineering

WORKING IN THE OPERATIONS FLIGHT MAINTENANCE ENGINEERING

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This volume in this pamphlet series describes the Air Force Engineer's role in activities required to operate, maintain, repair, and construct installation real property using an in-house military and civilian work force and recurring and nonrecurring service contracts. This volume provides detailed guidance for performing the Maintenance Engineering mission. The Maintenance Engineering Element provides engineering expertise for the Operations Flight, support of infrastructure/facility project review, program management, non-design drafting, service and utility contract management, and work analysis/methods improvement. This pamphlet series supports AFI 32-1001, *Operations Management*, as the AFI which implements AFPD 32-10, *Installations and Facilities*.

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Chapter 1 Introduction to the Maintenance Engineering Flight

1.1 Organization and Function

Volume 2, Maintenance Engineering is a guide to the mission, objectives, and management of the Maintenance Engineering Element of the Operations Flight. The pamphlet offers guidance by suggesting options and tools to successfully perform the mission. Successful alternatives to these suggestions are encouraged and authorized.

The Operations Flight is responsible for all activities required to operate, maintain, repair, and construct installation real property. The flight is composed of five elements to process requirements in an efficient and timely manner. These elements are Maintenance Engineering, Facility Maintenance, Material Acquisition, Infrastructure Support, and Heavy Repair.

1.2 Mission

The mission of the Maintenance Engineering Element of the Operations Fight, as stated in AFI 32-1001, *Operations Management*, Section C, 11.2, follows.

Maintenance Engineering's mission is to provide engineering expertise for the operations flight, support of infrastructure and facility project review, program management, drafting, service and utility contract management, recurring work program, and work analysis and method improvement.

1.3 Objectives

The Element has seven overall objectives:

(1) provide engineering expertise,
(2) project review,
(3) infrastructure program,
(4) non-design drafting,
(5) service and utility contract management,
(6) recurring work program management (RWP), and
(7) work analysis and methods improvement.

The following is a brief review of these objectives. Chapters 2 through 9 are an in-depth look at each, providing guidance and offering tools and suggestions that can be used to meet the objectives; thus, fulfilling the mission of the Maintenance Engineering Element.

1.3.1 Provide Engineering Expertise

The Maintenance Engineering Element Provides engineering expertise by supporting operations with on-call expertise in analyzing field problems and identifying solutions. The Element supports work order planning when engineering design considerations apply.

1.3.2 Project Review

The Operations Flight is the focal point for Engineering Flight project review. Maintenance Engineering reviews all project designs and coordinates the impact of projects with the appropriate work centers. The Element also reviews projects from the standpoint of maintainability, reliability, and energy management.

1.3.3 Infrastructure Program Management

The Element manages infrastructure systems by assessing the system's technical condition, evaluating the repair options and priorities, and planing and programming repairs and improvements.

1.3.4 Non-design Drafting

To satisfy the non-design drafting objective, the Maintenance Engineering Element oversees as-built drawing management, maintains Base Comprehensive Plan tabs, and produces non-design drawings and documents. Management of a centralized vault of record drawings ensures drawing existence and accuracy. The Engineering Flight often retains ownership of the vault or assumes shared responsibilities with Maintenance Engineering.

1.3.5 Service and Utility Contract Management

The Element manages all service contracts, with the exception of Housing Service contracts, and provides customer interface.

1.3.6 Recurring Work Program

The Recurring Work Program is improved by the support of the work centers' overall development and annual assessments by Maintenance Engineering and by ensuring manpower is used in the most cost-effective manner.

1.3.7 Work Analysis and Methods Improvement

Operations Flight processes, resources, and mission requirements are analyzed by Maintenance Engineering to provide recommendations to the flight chief and element leaders on resource allocation, work execution, and process improvement.

1.4 Manpower

Air Force Manpower Standard (AFMS) 44EO details the manning for the Operations Flight. Using the detailed formulas and determining the applicable manpower ranges, manpower managers can consult the provided Standard

Manpower Tables to identify the manning of the Maintenance Engineering Element needs.

While some command and base variations may make manning requirements unique, the Civil Engineering (CE) formed the original, typical Maintenance Engineering section with a military CE officer as the chief; civilian engineers in the various disciplines; and a mix of engineering Air Force specialties (AFS) personnel (3E5X1). Variations may be pursued in accordance with the AFMS.

1.4.1 Training

The appropriate training prior to assignment is essential for acceptable work performance.

1.4.2 The Maintenance Engineer

The only Operations Flight company grade officer's position under the AFMS is in Maintenance Engineering. This position is for a senior unit company grade officer, or civilian equivalent, and is necessary to provide the breadth of experience to the Operations Flight and engineers. The position also provides CE officers with leadership and Operations Flight experience. Deployable teams often have the Maintenance Engineer serve as the Operations Chief for the team commander, usually the squadron's Base Civil Engineer (BCE) or Operations Chief. In some cases, a civilian is selected to bring added continuity to Element programs.

1.4.3 The Engineers

The program engineers are the three civilian positions (civil, mechanical, and electrical) of the core Objective Squadron who perform the engineering portions of the mission. The positions were designated civilian to provide continuity and depth-of-experience with the base infrastructure. They provide needed operations and infrastructure experience to develop the engineers for squadron leadership positions such as Chief of the Engineering or Environmental Flights and, ultimately, the Deputy Base Civil Engineer.

Lieutenants/Junior Captains. Engineer positions can be filled with lieutenants and junior captains. Young officers are often rotated within the squadron to achieve breadth of experience. This provides officers with exposure to the Operations Flight early in their career and should prove beneficial later when they serve as Maintenance Engineers or Chiefs of Operations.

1.4.4 The Engineering AFS Personnel

The core Objective Squadron has four engineering AFS positions: three dedicated by AFMS to quality assurance evaluation (QAE) duties and one to non-design drafting support.

1.4.4.1 The Quality Assurance Evaluators

Actual QAE manning requirements should be determined using AFI 63-504, *Quality Assurance Evaluator Program* and the AFMS flexibility to realign manpower. Civilians provide continuity for bases with high rates of deployment or other military taskings; however, military personnel require experience to perform these duties during contingencies.

1.4.4.2 The Non-design Draftsmen

This is one position in the core Objective Squadron. Although this position is well suited to the military, specific bases may have civilian experts currently dedicated to maintaining the BC Plan tabs and as-builts. This position allows the person in the 3E5X1 position to gain valuable experience using drafting and Computer Assisted Design and Drafting (CADD) support and interfacing with the Engineering Flight, various contracts, and the facility maintenance work centers.

1.5 Matrixing

Productivity gains are achieved through matrixing. Matrixing is the movement of personnel within an element to support an identified shortage in a skill level, AFS, or specialized work task. Inspection of specialized service contracts is one example where craftsmen are used to augment quality assurance evaluators in the Maintenance Engineering Element.

The pamphlet, AFPAM 32-1004, *Working in Resources Flight*, is, primarily, a source of processes for accomplishment of the Flight's mission. This volume lists processes for accomplishment of the Maintenance Engineering Element mission, including how it relates to other flights and other elements.

Chapter 2 Provide Engineering Expertise

2.1 Objective

The primary purpose for Maintenance Engineering is to manage real property maintenance and to provide engineering expertise to the Operations Flight. The tasks of this objective include:

(1) supporting the work center craftsmen in planning work orders by coordinating engineering design considerations, as necessary and
(2) supporting work execution with on-site engineering evaluations and recommendations, as required by the work centers.

2.2 Work center Coordination

These tasks require field experience in engineering and a long-term relationship with the craftsmen. Craftsmen would be unlikely to call on the skills of a transitory and/or inexperienced engineer. To develop field experience and long-term relationships, the Maintenance Engineering engineers should:

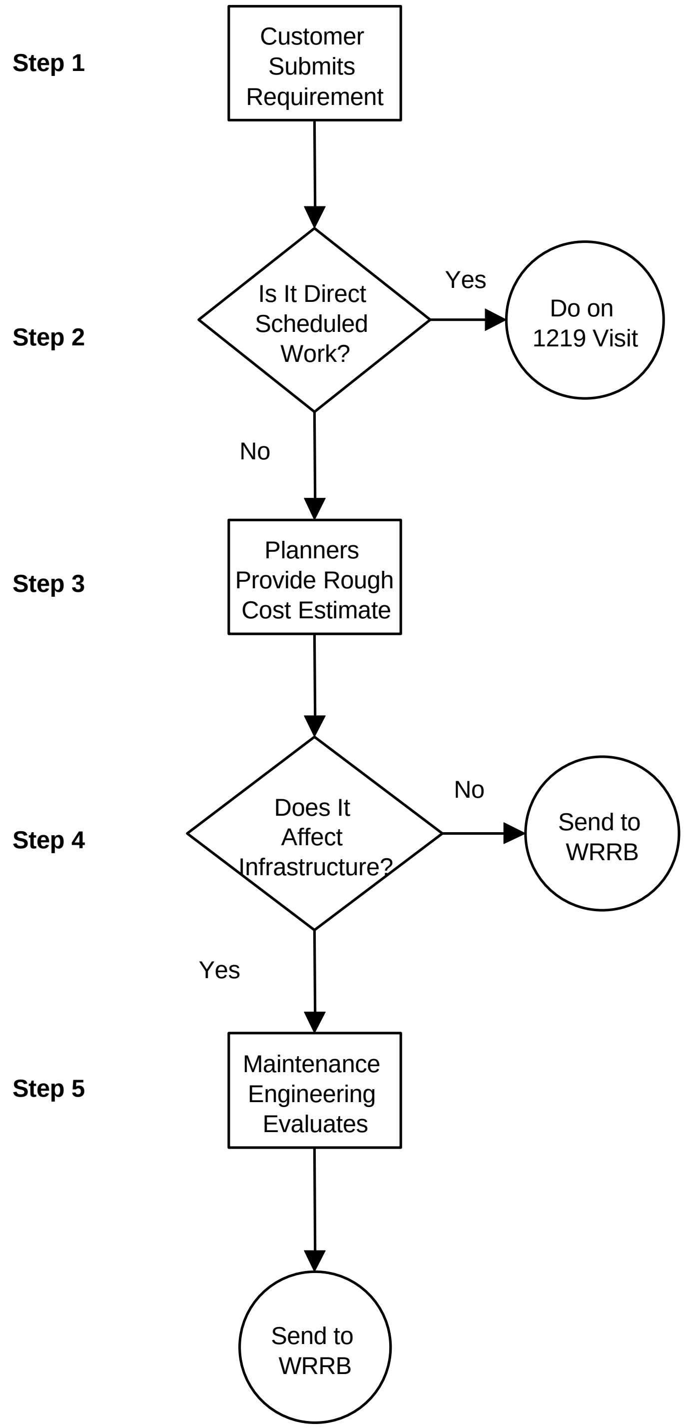
(1) meet regularly and informally with the craftsmen in the engineer's discipline to discuss program considerations, work orders in planning and in progress, engineering projects, and work center concerns and
(2) visit the work centers and sites of all work orders in progress and completed, on a weekly schedule.

This long-term relationship and field experience will benefit the engineer and the organization in all other objectives and is a cornerstone of the Maintenance Engineering mission.

2.3 Work Orders

The work order process is described, in detail, in AFPAM 32-1004, *Working in Operations Flight*, *Volume 3 Facility Maintenance*. Briefly, the work order process for Maintenance Engineering involves review and evaluation. Figure 1, Work Order Review and Evaluation, depicts the process.

Figure 1. Work Order Review and Evaluation



Every work order follows the following steps.

(1) **Step 1 —** A customer identifies a requirement to their zone service desk.

(2) **Step 2 —** The zone force manager and supervisor determine if the requirement is an emergency or can be accomplished via direct scheduled work on the next 1219 visit or as a work order.

(3) **Step 3 —** Work orders go to the appropriate work center-of-execution for initial evaluation and rough estimate. Usually, the Heavy Repair force manager, the focal point for the Work Request Review Board (WRRB), manages the work orders.

(4) **Step 4 —** Many work orders affect the base infrastructure. Maintenance Engineering should evaluate each one and recommend action.

(5) **Step 5 —** Following the Maintenance Engineering evaluation, the work order should go to the WRRB for final evaluation and approval.

2.3.1 Evaluating a Work Order

When the Maintenance Engineer receives a work order, it should be passed to the program engineer responsible for the affected infrastructure program. This engineer evaluates the work order asking several questions:

Is this work necessary to meet the customer's needs?

Frequently, the customer wants the effect, or outcome, of the work; but, not necessarily the work requested. For example, a customer requests more fluorescent light fixtures in a dropped ceiling. What the customer really wants is more desk light. The solution may be to move the existing fluorescent fixtures above the desks, or install track lighting above the desks, or use natural light. The engineer should contact customers to discuss their needs and visit the sites to determine the proper method.

Is this work going to positively or adversely affect the infrastructure program?

Customers do not concern themselves with the impact of a request on infrastructure. Energy costs, additional HVAC load, roof penetrations, and pavement integrity are the concerns of the program engineers. If the proposed work will affect the infrastructure program, the engineer should note it, discuss the impact (including costs), and discuss alternatives with more favorable impact. In the end, the engineer may advise disapproval due to the adverse impact.

Is the work duplicating or negating other planned work, especially the work in the long-range plans?

The engineers should examine projects in their long-range plans to identify duplicate work. If the work affects a portion of a programmed project, the engineer should note it, discuss the impact to the project if the work is executed via the work order, and provide a recommendation. Often mission requirements may drive a programmed project to be executed earlier and is advantageous to the program.

How should the work be executed?

The engineer should determine if it is an in-house work order, a contract project, an IDIQ project, a SABER project, or a small purchase effort. The cost estimate and type of work are important considerations to this evaluation.

Is the work valid?

The engineer should provide an approval or disapproval recommendation. The time spent by the engineer evaluating the project will exceed that which the approval authority will have in the WRRB. A professional recommendation is valuable to them in making their decision.

NOTE

An engineer should not recommend disapproval without first discussing with the customer the concerns driving this recommendation. Customers, when facing sensible concerns over their work request, will often re-examine and even withdraw it.

After program engineer review, the Maintenance Engineer should review the work order asking the same questions and develop a recommendation for approval/disapproval. Most Maintenance Engineers sit on the WRRB and may be questioned about their engineers’ evaluations. With this coordination, the work order returns to the review process and proceeds to the WRRB.

Chapter 3 Project Reviews

3.1 Review Procedures

To ensure all CE operations, base long-range plans, and engineering projects are complimentary, the Maintenance Engineering engineers should review all engineering projects.

> **NOTE**
> SABER projects must also be reviewed. SABER designs are typically quick and simple, prepared by craftsmen or engineering personnel with no formal consideration of long-range infrastructure requirements.

(1) At every stage in which an engineering project comes due for review:

(2) The engineer should obtain a copy of the project and provide a timely, independent review to ensure the design meets the government's needs (discussion follows on maintainability and reliability).

(3) The Base Comprehensive Plan and the Maintenance Engineering programs (long-range plans) should be reviewed to ensure the project meets the long-range plans.

The engineer should meet informally with the work center planners and senior craftsmen to discuss the project, review the plans, and ensure current and planned work are in agreement.

3.2 Work Order Reviews

The program engineers should be cognizant of the engineering projects programmed and under design. They should ensure that day-to-day Operations Flight work coincides with the project plans or that changes to the project situation (due to Operations Flight work) are passed to the project engineers.

3.3 Timely Reviews

Engineering project reviews must be timely. Timeliness is an important factor in creating a successful working relationship between the Operations and Engineering Flights.

3.4 Maintainability and Reliability

Operations Flight reviews use maintainability and reliability as primary criteria for the evaluation of projects (ETL 88-4 - *Reliability & Maintainability (R&M) Design Checklist*).

3.4.1 Maintainability

A primary objective and priority in the design and modernization of real property is maintainability.

Occasionally, low investment cost has been an overriding design consideration. However, this approach can result in high operations and maintenance cost over the life of the facility. Unacceptable and low-standard construction can result in downtime and accelerated deterioration. Construction projects should strive for the lowest life-cycle cost as a primary design criteria.

To ensure maintainability, the engineer should identify systems and components that historically have low- or high-maintenance (life-cycle) costs. Work center planners and senior craftsmen are primary sources of information. They work daily with the infrastructure in question and know which systems perform best and which systems fail first. Examples of various construction types that have historically proven high- or low-cost in maintainability follow.

Exterior Finishes — Durable surfaces that are both architecturally pleasing and relatively maintenance free (e.g., vinyl or masonry vs. wood siding) should be specified.

Interior Finishes — Low-maintenance, high-durability finishes such as vinyl wall coverings (with sizing) rather than paint, wainscoting, and corner protectors should be used.

Windows — Metal casings and sashes with baked-on, dipped, or anodized finishes for low maintenance and double glazing (high R value) increase energy efficiency and lessen noise when used.

Roofs — Pitched roofs, whenever feasible, result in fewer leaks, improved insulation, and longer life. Equipment should not be mounted on roofs.

Mechanical Systems — Centralized monitoring, control, and maintenance points (e.g., direct digital control) should be incorporated in the design; as well as easy access features for operations and maintenance.

Utility Distribution Systems — Systems should be looped for system backup and there should be adequate shutoff points for safe and effective troubleshooting, isolation, and repair.

Streets and Roads — There should be sufficient pitch and drainage to prevent base failures and potholes.

Specifications — Use of off-the-shelf materials, systems, and components should be encouraged.

Corrosion Control — Nonmetallic components for buried utilities should be used whenever possible. On buried metal components, cathodic protection and protective coatings appropriate for the environment should be installed.

3.4.1.1 Improvement Considerations

When reviewing renovation projects, engineers should look for opportunities for maintenance improvements; such as, replacing worn, obsolete, and inefficient systems with modern, reliable, and easy to maintain systems.

Some equipment items can come with zero maintenance features, such as sealed bearings motors. This equipment can cost more; but, in the long run, can save the squadron in manpower and dollars. (Preventive maintenance cost analysis is discussed in Chapter 8, Recurring Work Program Support.)

3.4.1.2 Infrastructure Maintainability

In addition to the equipment, the facility or infrastructure must be designed to accommodate maintainability. A mechanical room may be designed to accommodate the necessary HVAC equipment, but easy access to the motors, drive shafts, pumps, and even filters is prevented. Placing equipment on roofs or in attics may be aesthetically pleasing, but prevents proper maintainability. Equipment should be placed on the ground with appropriate aesthetic and ventilated screening.

3.4.2 Reliability

Reliability refers to installation of systems that are dependable. For example, electronic controllers in heating, ventilation, and air conditioning (HVAC) equipment have proven more reliable than pneumatic controllers. High-efficiency motors provide another example. The best sources of reliability data are the senior craftsmen and the program guidance.

3.4.3 Review Management

Some bases require the signatures of both the Maintenance Engineer and program engineer on all contract design documents. This ensures the Operations Flight personnel review all construction projects and places Maintenance Engineering in the role of manager of this process. The Maintenance Engineer vouches on the documents that operational concerns have been monitored throughout the design process.

The tempo of the Operations Flight can inhibit timely reviews by the work centers. Some bases have found that formal, periodic meetings between the program engineers and their craft counterparts can build a routine. This routine aids the work center participation and provides a forum for project reviews, in addition to other infrastructure programs and craft issues.

The role of Maintenance Engineering in engineering project reviews does not end at the completion of the design phase. Program engineers should be aware of each construction project underway that affects their programs and, periodically, visit the sites to ensure the contractor complies with critical aspects of their program. Participation of both the engineer and work centers in pre-acceptance, verification of as-builts, and knowledge of warrantee periods are also critical to successful programs.

Chapter 4 Infrastructure Program Management

4.1 Management Objective

Infrastructure program management was one of the most critical objectives that too often went incomplete due to day-to-day design and construction tempo in the old functional squadron. The Civil Engineer, by realigning this duty under Maintenance Engineering, put an emphasis on the requirement to manage infrastructure systems. Facilities and aesthetics will often take care of themselves and the customers are concerned with these systems long before they fail catastrophically. However, the infrastructure requires expert oversight to assess its condition, evaluate repair options and priorities, plan and program the repairs and improvements over a long-range, and, then, advocate for the repairs and improvements. The customers are not concerned with roofs and transformers until they fail. However, once failed, it's too late to plan for a cost-effective, long-range maintenance, repair, and improvement program.

4.2 Management Methods

Management of an infrastructure system in a long-range program requires a basic, overall method involving inventory, assessment, development of program requirements, setting priorities, planning, and advocacy.

4.2.1 Inventory

A program engineer needs a clear understanding of the infrastructure components to be managed and provide the organization with the information. The engineer will later collect assessments of the components and develop projects affecting components. An inventory system is necessary to organize the information. Methods for managing the inventory include Work Information Management System (WIMS) and other software, spreadsheets, maps, and folders.

Many WIMS features will support the program engineer in managing infrastructure. WIMS contains data on facilities, work orders, and projects. The RWP contains specific information on each type of system within each building that requires periodic work. The real property records provide a starting point for the program inventory. Real property records list all the facilities on a base and information on roofs and HVAC systems. For more specific roof information, WIMS has a separate roofing management system.

Other than WIMS, the government has developed several automated infrastructure management systems available to the base program engineers. MicroPaver is most commonly used. This software provides the system necessary to manage the airfield pavements in the detail required by the Air Force. Other systems developed by the Army Corps of Engineers include MicroPiper and MicroRoofer (available through the Defense Technical Information Center service through the base technical library). These systems are very complex, and can be very labor intensive to use. They require exact information on the infrastructure components. For example, MicroPiper inventories each length of pipe and each connection separately; requiring all dimensions and parameters. However, once these details are loaded, the systems are very effective in delivering maintenance and repair recommendations and priorities.

Industry and state/local governments have also developed systems to support the management of infrastructures. The market is large for commercial infrastructure management systems. Systems are available with a little or as much detail as desired. Commercial software should be Windows-type compatible in software that is structured query language (SQL) compliant and have open database connectivity (ODBC).

NOTE

Air Force Civil Engineering is currently evaluating various commercial packages for use in the next-generation Automated Civil Engineer System (ACES). Incompatible software could render data useless, requiring that it be reloaded manually into the programs selected to interface with ACES. Additional information can be provided by HQ AFCESA/CEOA, 139 Barnes Drive, Tyndall AFB (DSN 523-6372).

Spreadsheets can organize the information in a format that facilitates queries, reports, and other calculations. Often, different categories of components may require separate spreadsheets. A simple spreadsheet will include:

(1) listing of the components (normally categorized by type: built-up roofs, single ply, standing seam);
(2) appropriate demographics on each component: make, model, manufacturer, vendor, when installed;
(3) maintenance recommendations on each component;
(4) recommended overhaul and/or replacement date;
(5) periodic assessment observations and rating.

An example is the refrigerant spreadsheet described in the AFCESA *Refrigerant Management Handbook.*

One of the most effective graphic methods to capture the state of the inventory is through color-coded maps. Base maps, hand-marked with highlighters or plotted on a CADD, identify the number and type of components and the condition of each. For example, the base roofing engineer may use a base map for each roof type (built-up, single-ply). Each map is color coded for age or condition: black = 20+ years or failed, red = 10-20 years or serious defects, yellow = 7-10 years or moderate defects, and green = new-7 years or no defects. Maps will enhance any inventory system by providing a visual picture of the system status. These maps also serve as an effective briefing tool.

Before computers were used, engineers managed inventories in card files or on paper in folders. Depending on the complexity and size of the program, it is possible to effectively manage it on paper spreadsheets or card files. The information tracked is the same tracked on the computerized spreadsheets.

4.2.2 Assessment

Once the program engineers have identified the total parts of their infrastructure, they should conduct an assessment of the parts. An assessment reviews the condition of infrastructure components, defects, efficiency, potential lifespan, costs to operate, projected load increases, and potential for failure. Some objective technical condition rating should be assigned to each. Assessments can be accomplished a number of ways.

AFMC developed a series of technical condition standards to objectively evaluate the many and varied components of real property using a standard rating scale. AF/CE has reviewed, revised, and is in the process of publishing these standards. A copy may be obtained from AFCESA/CESC, 139 Barnes Drive, Tyndall AFB (DSN 523-6470). These standards provide a measurement tool for most types of infrastructure to assign a generic rating to each. The ratings provide a means of comparison across the infrastructure program and across programs for assigning priorities to projects and funds. The generic format of the standards is shown in Table 1, Condition Standards.

Table 1. Condition Standards

CONDITION	GENERIC RATING	STANDARD EVALUATION MEASUREMENT
10	New Condition	Like new with no defects; system is fully operational; no repairs required.
8	Minor Defects	System fully operational; only preventive maintenance and minor repairs required; some minor efficiency loss due to defects; in some cases, system could be upgraded.
6	Moderate Defects	System down no more than once a year; no backup system; moderate loss of efficiency; repairs and/or upgrade required on a regular basis.
4	Serious Defects	System down for unscheduled maintenance and repair no more than three times a year; efficiency far below standards; extensive repairs required on a regular basis.
2	Excessive Defects	System down frequently; no longer efficient; major overhauls or replacements required.
0	Failed	System no longer functions or efficiency so poor, not cost effective to operate; replacement or total overhaul required.

This rating system provides a fair, uniform rating to allow comparison of different systems for funding priorities. In all the condition standards, list all important components of the infrastructure to be assessed, describe what conditions to evaluate, and indicate the seriousness of the various conditions.

The DoD has developed many other assessment standards and tools for use in evaluating systems; three follow.

4.2.2.1 DoD Condition Assessment Survey (CAS) Program

The most extensive system under development to date, CAS consists of 32 volumes of about 60 pages each. The Air Force has found this system too cumbersome and labor-intensive to use.

4.2.2.2 Program Guidance Checklists

Most formalized programs (e.g., pavements, roofs, energy) have checklists referenced and available for any of the infrastructures managed.

4.2.2.3 Facility Investment Metric (FIM) Program

The FIM system assesses the quality of the structure in support of the mission based on measurement of specific requirements. While the program has useful criteria for evaluating needs, the criteria does not attempt to assess building systems or infrastructure systems.

4.2.2.4 Assessment Follow-through

Industry and state/local governments have also developed standards. Contacting these agencies can help engineers obtain or develop a set of standards or methodology that best serves the infrastructure(s).

The program engineer(s) and senior craftsmen should collaborate on assessing the infrastructure. While this collaboration can take place in an informal review meeting, a successful alternative is regular formal assessment studies. In these studies, the program engineer and the senior craftsmen perform site visits to infrastructure components to assess the components using a set of standards and develop a plan from these visits. (4.3, Management Concepts, provides a successful way to implement this initiative.)

For most infrastructure systems, commercial specialists will assess the systems; objectively rate the components; and develop a maintenance, repair, and replacement program. In some cases, these contracts will alleviate manpower-intensive requirements when manning support is unavailable. The contractor can also provide critical technical expertise and/or systems not available at many bases (e.g., infrared roof evaluation systems). Regular assessment contracts should be considered for many programs. For example, the energy program recommends an Energy Conservation Opportunity Analysis to support the program.

4.2.3 Developing Program Activities

Following construction of the inventory and the assessment, the program engineer must now evaluate the infrastructure systems by components and types and, then, as an entire system, determine the best management method. The requirements identified during the assessments need to be developed into program activities: RWP, direct scheduled work orders, work orders, or engineering projects including simplified acquisition of base engineering requirements (SABER), operation and maintenance (O&M) contracts, military construction (MILCON) projects, and indefinite delivery/indefinite quantity (IDIQ) delivery orders. The program engineer should consider:

(1) The priority of the work — Does it need to be done now? What is the mission impact if it is delayed? What is the likelihood of system failure?
(2) The scope of the work — Who has the expertise to perform the work? How big is the effort?
(3) The best method to execute — Can it be consolidated with other like work requirements? Will an expert be used?
(4) Funding avenues.

When the work requirements have been developed into a program activity, the program engineer should:

(1) prepare the work request,
(2) coordinate a short cost estimate with the work centers,
(3) track through the approval process, and
(4) coordinate the execution priorities as appropriate.

NOTE

IDIQ contracts have become an attractive alternative to firm-fixed price contract projects for infrastructure system repairs. IDIQ contracts can take advantage of available funds and provide the base flexibility to execute critical repairs with less design and fewer contracting delays.

4.2.4 Setting Priorities

A unit will never have enough resources to fulfill all requirements. Man-hours and funds been reduced drastically in recent years and they will continue to be reduced. The key to optimizing a unit's resources and meeting the most critical needs is properly prioritizing all of the work requirements After the requirements have been developed into a program activity, the program engineer then identifies which activities have priority. Mission requirements and infrastructure maintenance requirements may frequently be in conflict. The task of the program engineer is to prudently balance the priorities for both areas.

4.2.4.1 Mission Impact

The mission should always affect the decisions on priority. For example, two identical boilers, each supporting their respective facility, need service. Boiler 1 supports the command post. Boiler 2 supports the thrift shop. Applying mission criteria, Boiler 1 would receive service first, even though Boiler 2 may be in worse shape. The Facility Investment Metric (FIM) is a system used to apply mission priorities to work requirements.

The basic mission impact rating system in AFI 32-1001, *Operations Management*, for prioritizing requirements is:

(1) **Priority 1 - Mission**. Work in direct support of the overall base mission that, if not done, would reduce operational effectiveness.
(2) **Priority 2 - Safeguard Life and Property**. Work needed to give adequate security to areas subject to compromise; to eliminate health, fire, or safety hazards; or to protect valuable property or equipment.
(3) **Priority 3 - Support**. Work that supports the mission or prevents a breakdown of essential operating or housekeeping functions.
(4) **Priority 4 - Necessary**. Not qualifying for higher priority.

These ratings provide gross categories for dividing work requirements. The work requirements can be given additional priority levels using decimal priority numbers (e.g., 1.1, 3.25). Examples are:

(1) **Mission** — Airfields are often higher priorities than mission support facilities, such as hangers.
(2) **Safeguard Life and Property** — Most of these projects have an assessment of the seriousness of the condition. Safety conditions are given risk assessment condition (RAC) codes used to subdivide priorities. RAC 1s = Priority 2.0, RAC 2s = Priority 2.25, etc.
(3) **Support** — Most base facilities fall under this heading; however, these facilities are ranked by priority. The CE water work center is a higher priority than the local civilian personnel office.

4.2.4.2 Objective Technical Criteria

While mission impact is under consideration, the program engineer must also compare technical requirements. Using the two boilers in the above example: the boiler in the command post has minor defects that may be repaired during summer overhaul. The boiler in the thrift shop has failed. In this case, the thrift shop boiler should be considered first for immediate repair or replacement.

The technical criteria for comparison across programs, should be objective, consistent, and generic. A good example is the previously cited Condition Standards. Using these standards will not only provide a systematic approach to prioritizing projects within and across programs, but they also describe some mission impact. Used with the mission impact criteria, a total priority system can be developed.

The program engineer's job is to make recommendations on the allocations of resources from the available criteria. Unique priorities of each commander, on each base, and in each command can modify these recommendations. For example, emphases on quality of life, base appearance, or preparation for a coming distinguished visitor will change priorities and create unplanned work. The program engineer must show consideration of these emphases, accept the changes in priorities, support the work, and manage the program to accommodate the changes.

4.2.5 Planning the Requirements

The result of the inventory, assessment, development, and, setting of priorities is the development of comprehensive, long-range plans. The program engineer should monitor and support the progress of the work requirements in the recurring work program, the direct scheduled work orders (or 1219 work), the work order schedule [referred to as the In-service Work Plan from the old Base Engineer Automated Management System (BEAMS) days], the long-range O&M contract project plan, and the MILCON program.

Originally, the long-range plans were known as five-year plans. Many commands and bases have converted to six-year plans to match the two-year budget cycle. Some programs, such as the Refrigerant Management Plan, require up to 20 years of planning. The long-range O&M contract project plan for each infrastructure program is documented in WIMS and managed by the program engineer.

4.2.6 Advocate the Requirements

The role of the program engineer does not end with the creation of schedules, plans, and programs. The program engineer is the dedicated advocate of the infrastructure and should participate actively in the ongoing review process.

The schedule for execution of work orders is developed from various criteria: age of work, customer priority, CE priority. Usually, this schedule is tracked within the zone or work element; often by a Heavy Repair controller. The program engineers should coordinate their program requirements directly with this controller. When conflicting priorities threaten the schedule, the program engineers should bring these issues to the appropriate superintendent for resolution. If necessary, all personnel involved should meet to resolve the conflict and develop the best possible schedule.

The O&M project program is centrally managed in the CEC program office. The program engineers should coordinate their program requirements directly with these program managers. When conflicting priorities affect the plans, the Maintenance Engineer should meet with the program office to help resolve the problem. The Maintenance Engineer should also seek out other appropriate funding programs such as Medical, Defense Logistics Agency, and the various energy programs.

The O&M project program is usually reviewed by the installation commander and the various unit and group commanders at the Facilities Board meeting. The program is reviewed and priorities and funding levels are discussed. The Board either enacts or discards the program engineer's recommendations. The Maintenance Engineer and program engineers should attend the meeting to:

(1) provide advocacy, as necessary, for the infrastructure projects;
(2) provide technical guidance; and
(3) observe the process of determining the base priorities to identify changes in the plans and better prepare future plans.

This board also provides an excellent forum to discuss and promote selected infrastructure programs in order to gain visibility for the requirements.

As each specific program is addressed, technical and managerial questions will arise that require support. An expert in each area of the programs can usually be found in the following organizations who can provide help as requested.

(1) Base MAJCOM.
(2) HQ Air Force Civil Engineer Support Agency - Technical Support Directorate; AFCESA/CES, 139 Barnes Drive, Suite 1, Tyndall AFB FL 32403-5319; DSN 523-6342.
(3) Air Force Institute of Technology, The Civil Engineer and Services School (the School House), Wright-Patterson AFB OH; DSN 785-5654.
(4) 366 Training Squadron, Sheppard AFB TX ("Tech School"); DSN 736-5800.

4.3 Management Concepts

4.3.1 Team Work

A facility evaluation group is a good way to conduct timely and comprehensive assessments of base facilities. All program engineers meet once or twice a month with senior craftsmen at a facility, usually in conjunction with a 1219 inspection. The group performs a whole-house technical evaluation, including all infrastructure elements (HVAC, roof, water/sewerage). All work requirements are logged; appropriate AF Form 332s are prepared and worked into the multi-year plans. One program engineer acts as the focal point for the program for organizing, managing the log, and ensuring the requirements are incorporated into the plans and, as completed, are closed out to the plans. The goal is to visit all major facilities in a year. The benefits include mutual support and consultation; synergy because, the disciplines identify more as a team than individuals; and improved engineer and work center technician coordination.

4.3.2 Coordinated Reviews

The long-range infrastructure programs can be significant portion of the Facility Board agenda. These programs are critical to mission support but budgets are shrinking. Infrastructure program engineers should attend these meetings and brief the Board on an overview of infrastructure needs in support of the BCE. The Maintenance Engineer should then brief the consolidated infrastructure program (see below). Fact-based decisions by the Facility Board in prioritizing base O&M project funds is the benefit of this type of review of the program.

Infrastructure cannot be ignored without degradation to the mission. Ensuring that infrastructure concerns remain visible to the installation command staff is challenging given the visibility of day-to-day concerns. A strategy to maintain awareness of the infrastructure program is to prepare a concise, consolidated program briefing package for the Facility Board meetings and for later use by the installation command staff at their offices. Attachment 3, Consolidated Facility Infrastructure Investment Program, is a modified copy of the package used at Hill AFB (Attachment 3) to support and promote their infrastructure program. It includes the following components.

Base Infrastructure Statistics — key to making the package attractive to commanders. The availability of statistics such as base acres, miles of roads, daily energy usage, workforce size, and total investment cost will entice them to retain the package for use in later reports.

Infrastructure Defined — provides clear, concise definition of base infrastructure in CE-specific terms.

Infrastructure Challenge —is the sales pitch. Why should the command staff be concerned about roofs, sewers, etc.? This section advocates for program funds.

Infrastructure Requirements — provides a synopsis of the funding requirements, by year if necessary.

Infrastructure Evaluation — details the state of the various infrastructure programs. The sample uses the condition standard assessments and FIM codes with a formula used by AFMC to develop a consolidated rating.

Funding Strategy and Strategy Summary — a synopsis of how the required funding will improve the conditions of the infrastructure to acceptable standards.

Infrastructure Projects — details the consolidated lists of projects in priority order, by fiscal year.

4.3.3 Computer-assisted Evaluations

The program inventory can easily be incorporated into a spreadsheet. This provides the capability to quickly sort and report, modify figures and see the results propagated through the program, and track all expected results. The usefulness of this tool can be enhanced through open database connectivity (ODBC) found in Windows-type applications.

Multiple applications can be combined to automate the presentation of program requirements and status. *Excel, AutoCADD, Paintbrush, MSWord, Access, and MS Project* can be linked together to create color-coded maps, programming documents, and project timelines. This information can be invaluable for management, as well as for the program engineer.

Chapter 5 Base Infrastructure Programs

Most bases have a unique set of programs emphasizing regional, state, or command emphasis. However, many programs are common throughout the Air Force and some are mandated. The following programs include the type of inventory system and assessment methods used; as well as a list of references.

5.1 Civil Programs

The civil programs include pavement, roof, water and wastewater, traffic management and signage, shelters, seismic management, and railroad management. Consult AFCESA/CESC, 139 Barnes Drive, Tyndall AFB FL 32403-5319, DSN 523-6470 on any of these programs.

5.1.1 Pavements

The most structured and complex of the civil infrastructure programs is the pavements program. It focuses on the assessment and management of the airfield pavements (runways, taxiways, aprons, ramps) using the detailed pavements management system, MicroPaver. Engineers may also use MicroPaver to manage roads, curbs, parking areas, and drives. Usually, these two types of pavements require two inventories due to the complexity of the airfield requirements.

Inventory System — MicroPaver and maps.

Assessment Methodology — Condition Standard surveys, contract (for specialized tests), visual (using Condition Standards or other criteria), and Air Force Pavements Team structural and skid assessments (coordinated through MAJCOM to AFCESA/ CESC)

References — AFMAN 32-1121V3 (airfields) and TM-5-623 (roads); AFMAN 32-1231, *Maintenance and Repair of Surface Areas*.

5.1.2 Roofs

The roof management program provides a systematic approach for the inspection, evaluation, maintenance, and repair of all roofing systems on the base. A properly executed maintenance program will detect problems before damage is widespread and add years to the life of the roof. The roof engineer establishes the program as prescribed by AFI 32-1051, *Roof Systems Management*. The roof engineer should monitor the basic maintenance on each roof, guard against any work or other activities violating roof integrity (e.g., placing equipment on the roof), and plan appropriate repairs and upgrades well-ahead of the potential for failure. Basic types of roofs include built-up roofs, single-ply roofs, and the preferable high-slope roof systems (asphalt shingles, metal roofs). The roof system is usually unseen and overlooked by the customers and should remain that way.

Inventory System — WIMS roof management program or spreadsheets, and maps (or Army's MicroRoofer).

Assessment Methodology — WIMS reports on age and leaks, contract (for specialized tests; e.g., infrared), and visual (using Condition Standards or other criteria).

References — AFI 32-1051, *Roof Systems Management*; MILHBK 1110/1, *Paints and Protective Coatings*; AFM 91-31, *Maintenance and Repair of Roofs*; ETL 90-1, *Built-Up-Roof Repair/Replacement Guide Specifications*; ETL 90-8, *Guide Specification for EPDM Roofing*; Roofing Industry Educational Institute (RIEI), *Maintenance Manual*; AFCESA Roofing Field Guides (Built-Up, Single-Ply, and Pitched).

5.1.3 Water and Wastewater Systems

The water and wastewater systems program objective is to ensure 100 percent availability of these critical utilities. The programs are often divided into water supply systems (potable, non-potable, and fire suppression) and wastewater removal systems (sanitary and storm). Systems include the piping/valving, retention structures, channels, connections, manholes, pumps and lift stations, and treatment plants. As the nation's conservation and environmental concerns grow, management's attention to these systems is expected to increase. Many communities have been pressed to upgrade their systems to reduce infiltration and inflow. A long-range plan for the upgrade of the systems will ensure the program engineer can support the increasingly demanding requirements.

Inventory System — Spreadsheets and maps (or the Army's MicroPiper system).

Assessment Methodology — WIMS reports on age and leak histories; flow rate evaluations; contract (for specialized tests; e.g., micro-camera, infrared, sonic); and visual (using Condition Standards or other criteria).

References — AFI 32-1040, *Water Systems*; AFR 91-26, *Operations and Maintenance. of Water Systems*; AFM 88-11V1, *Sanitary and Industrial Wastewater Collection-Gravity Sewers and Appurtenances*; AFM 88-11V2, *Sanitary and Industrial Wastewater Collection - Pumping Stations and Force Mains*; AFM 88-11V3, *Domestic Wastewater Treatment*; AFJMAN 32-1079, *Maintenance and Operation of Water Supply, Treatment, and Distribution Systems*; AFM 88-10 V1, W*ater Supply, Sources and General Considerations*; AFM 88-10 V3, W*ater Supply, Water Treatment*; AFM 88-10 V5, *Water Supply, Water Distribution*; AFM 88-10 V7, *Water Supply for Special Projects*; and ETL 87-1, *Lead Ban Requirements of Drinking Water*.

5.1.4 Traffic Management and Signage

Most bases rarely have the traffic flows and patterns requiring in-depth traffic engineering (e.g., queuing theory and flow capacity analyses). Typically, it is the pavements engineer who serves as CE traffic engineer and provides support in resolving the smaller traffic management problems and meeting the Air Force signage guidance.

Inventory System — Spreadsheets and maps (of signs).

Assessment Methodology — Security police accident records; visual (using Condition Standards or other criteria such as windshield survey with maps); and contract, rarely for true traffic engineering concerns (e.g., highways through bases).

References — AFP 88-40, *Sign Standards* (programmed to be AFPAM 32-1097); AFJMAN 32-1017, *Highways for National Defense* (under revision - the old AFR 75-88); Army Regulation 55-80, *Manual of Uniform Traffic Control Devices (MUTCD)*, published by Department of Transportation and obtained through the technical library using the Federal Register to list of current updates.

5.1.5 Shelters

To support operational mission requirements, most bases have shelters and a shelter program. The program manages shelters and all hardened operational facilities. It is the responsibility of the program engineer to analyze these facilities, develop retrofit and improvement options, and manage the repair and upgrade plans.

Inventory System — Spreadsheets and maps.

Assessment Methodology — Structural analysis and contract assessments.

References — Army TM 5-855-1 (programmed to be replaced with AFJMAN 32-1055, *Joint Services Manual for the Design and Analysis of Hardened Structures to Conventional Weapons Effects*); AFR 88-22, *Structures to Resist the Effects of Accidental Explosions, Introduction*; AFM 88-3 CH1, *Design Criteria, Loads*; and AFM 88-3 CH14, *Design Criteria for Facilities in Areas Subject to Typhoons and Hurricanes*.

5.1.6 Seismic Management

The seismic management program is managed at bases in areas that experience significant seismic problems. This program can be quite extensive, requiring the program engineer to perform structural analyses, identify seismic risks, develop abatement options, and manage the repair and upgrade plans.

Inventory System — Spreadsheets and maps.

Assessment Methodology — Structural analysis and contract assessments.

References — ETL 93-3, *Inventory, Screening, Prioritization, and Evaluation of Existing Buildings for Seismic Risk* and AFM 88-3 CH13, *Seismic Design for Buildings.*

5.1.7 Railroad Management

Those bases with operational railroad systems should have a railroad program. This program engineer safeguards this transportation system by managing its maintenance, repair, and upgrade plans.

Inventory System — Spreadsheets and maps.

Assessment Methodology — WIMS reports on age and work requirements, contract assessments, visual (using Condition Standards or other criteria).

References — AFJMAN 32-1046, *Railroad Design, Construction , and Rehabilitation*; AFM 91-33, *Maintenance of Trackage* (programmed to be replaced by AFJMAN 32-1047); and AFM 91-44, *Railroad Track Standards* (programmed to be replaced by AFJMAN 32-1048).

5.2 Mechanical Programs

The mechanical programs include HVAC systems, refrigeration management, and fire protection. Suggestions for inventory systems, assessment methods, and resources are provided with the explanation of each mechanical program's system. Consult AFCESA/CESM, 139 Barnes Drive, Tyndall AFB FL 32403-5319, DSN 523-6459 on any of the mechanical programs.

5.2.1 HVAC Systems

HVAC management is the main mechanical program and includes all environmental systems: air conditioners, heat pumps, furnaces, boiler plants, heat exchangers, and exhaust fans. The program engineer responsible for the mechanical programs manages a large inventory of systems and components, requiring a complex inventory system.

Inventory System — Spreadsheets and maps.

Assessment Methodology — WIMS reports on age and work requirements, energy consumption analyses, contract assessments, and site visits (using Condition Standards or other criteria.)

References — AFI 32-1068, *Heating Systems and Unfired Pressure Vessels*; ETL 88-6, *Heat Distribution Systems Outside of Buildings*; AFP 91-35, *Refrigeration, AC, Evaporative-Cooling, and Mechanical Ventilating Systems*; and ETL 90-10, *Commissioning of Heating, Ventilating, and Air Conditioning (HVAC) Systems Guide Specification*.

5.2.2 Refrigeration Management

Refrigeration management is a recent program. Bases use it as a tool to manage their dwindling inventory of critical refrigerants and develop appropriate plans for replacement of the equipment. Implementing an effective refrigeration management program means having or implementing an effective HVAC program.

Inventory System — Spreadsheets and maps.

Assessment Methodology — WIMS reports on age and work requirements, manufacturer's information and EPA criteria, contract assessments, and site visits -(using Condition Standards or other criteria.)

References — AFP 91-35, *Refrigeration, AC, Evaporative-Cooling, and Mechanical Ventilating Systems*; ETL 90-10, *Commissioning of Heating, Ventilating, and Air Conditioning (HVAC) Systems Guide Specification*; and *Refriger-*

ant Management Handbook, Jun-94 (published by AFCESA, contact directly for a copy).

5.2.3 POL Systems

CE manages petroleum, oil, and lubricants (POL) delivery systems for AF vehicles and aircraft at the Liquid Fuels Maintenance (LFM) work center. This includes fuel tanks, piping, pumps, automatic valves, filter/separators, etc. This program requires that the program engineer (usually a mechanical engineer) work alongside with the LFM work center foreman, to verify the accuracy of system drawings, assess system condition, and identify system improvements.

NOTE

Responsibility for funding maintenance, repair, and minor construction work by contract and managing the MILCON rests with the Defense Energy Support Center (DESC).

5.2.4 Natural Gas

The program engineer responsible for the natural gas systems should verify the accuracy of system drawings, insure required maintenance is performed, and know the condition of the system and the requirements for repair/replacement.

References — AFI 32-1069, *Gas Supply and Distribution; Department of Transportation, Guidance Manual for Operators of Small Gas Systems*; 49 CFR 192, *Transportation of Natural and Other Gas by Pipeline: Minimum Federal Safety Standards*

5.2.5 Fire Protection

Infrequently, a base will require a fire protection engineer; usually, the mechanical engineer serves this purpose. The mechanical engineer should know the state of the base's fire protection systems to include the Aqueous Film Forming Foam (AFFF) systems in hangers, building sprinklers, status of fire extinguishers, emergency lighting and markings, and fire hydrants. The water and wastewater program engineer maintains the information on the hydrant system and the Fire Protection Flight maintains all remaining information to support the engineer.

Inventory System — Spreadsheets and maps (as necessary).

Assessment Methodology — WIMS reports on age and work requirements; contract assessments, and site visits (using Condition Standards or other criteria).

References — NFPA 101, *National Life Safety Code*; ETL 94-5, *Fire Protection Engineering Criteria and Technical Guidance - Emergency Lighting and Marking of Exits*; AFM 91-37, *Maintenance of Fire Protection Systems*; MIL HDBK 1008B, *Fire Protection for Facilities Engineering Design and Construction*; ETL 86-8, *Aqueous Film Forming Foam Waste Discharge Retention and Disposal*; ETL 90-9, *Fire Protection Engineering Criteria for Aircraft Maintenance, Servicing, and Storage Facilities*; ETL 91-1, *Fire Protection Engineering Criteria Testing Halon Fire Suppression Systems*; ETL 93-4, *Fire Protection Engineering Criteria - Automatic Sprinkler Systems in Military Family Housing (MFH)*; ETL 93-5, *Fire Protection Engineering Criteria - Electronic Equipment Installations*; ETL 94-6, *Fire Protection Engineering Criteria and Technical Guidance - Removal of Halogenated Agent Fire Suppression Systems*; ETL 95-1, *Halon 1301 Management Planning Guidelines*; and AFOSH STD 127-118, *Training Device Fire Protection*.

5.3 Electrical Programs

Electrical programs include electrical distribution, airfield lighting, corrosion control, industrial water treatment (IWT), alarm maintenance, and intrusion detection system programs. Consult AFCESA/CESE, 139 Barnes Drive, Tyndall AFB FL 32403-5319, DSN 523-6217 on any of these programs.

5.3.1 Electrical Distribution

The electrical distribution program ensures power (one of the primary mission utilities) continues to flow. The systems involved in electrical distribution are the base power plants, main feeders, substations, primary circuits, transformers, generators, power lines, and, often, the circuits right to the building circuit boxes. Also included are support systems such as oil pump stations. In recent years, poly chlorinated biphenyls (PCBs) and energy conservation have placed an increased emphasis on this program.

The environmental impact of PCBs has required an inventory and replacement plan for all transformers using PCBs. PCB transformers must be treated as hazardous waste until purged. The electrical systems work center or the program engineer should be contacted to ensure this plan has been developed.

The requirements for energy conservation are discussed under the energy program in section 5.4.1 of this chapter. Only by employing efficient components and having a plan for metering the maximum number of users economically possible to allow analysis of energy problems will the program meet the energy goals.

Inventory System — Spreadsheets and maps.

Assessment Methodology — WIMS reports on age and problems, energy consumption evaluations (preferably from meters), contract (for specialized tests), and visual (using Condition Standards or other criteria).

References — AFJMAN 32-1080, *Electrical Power Supply and Distribution*; AFI 32-1062 (replaces AFR 91-45), *Electrical Power Plants and Generators*; AFI 32-1063 (replaces AFR 91-4), *Electrical Power Systems*; AFI 32-1064 (replaces AFR 91-12), *Electrical Safe Practices*; AFJMAN 32-1078, *Electrical Worker Safety*; and AFJMAN 32-1082 (replaces AFM 91-3), *Facilities Engineering, Electrical Exterior Facilities*.

5.3.2 Airfield Lighting

The airfield is always a primary focus as it is the crux of the base mission. Supporting airfield lights and other visual air navigation systems is, therefore, a primary concern of CE units. The systems include all substations, circuits, light systems, and vaults associated with lighting. The program engineer should also maintain a base lighting program to support those circuits and systems of both airfields and roads.

Inventory System — Spreadsheets and maps.

Assessment Methodology — WIMS reports on age and problems, energy consumption evaluations (from meters is best), contract (for specialized tests), and visual (using Condition Standards or other criteria).

References — AFI 32-1044, *Visual Air Navigation Systems*; AFJMAN 32-1076, *Design Standards for Visual Air Navigation Systems*; AFP 91-28, *Real Property Operations and Maintenance of Airfield Visual Aid Facilities*; and FAA Advisory Circular AC 150/5340-26.

5.3.3 Corrosion Control

The annual corrosion cost in the US is estimated to be about $150 billion. The cost to Air Force Civil Engineering is estimated at $500 million ($3-$4 million average). Controlling corrosion is a primary concern of CE. Corrosion control usually consists of two primary programs: cathodic protection and protective coatings.

5.3.3.1 Cathodic Protection

Unprotected underground metal structures, primarily steel, corrode rapidly because they are exposed to soil moisture, the key ingredient in this electrochemical environment. Cathodic protection is the system which provides a cathodic potential to the structure preventing the electrochemical corrosion. This is done by using sacrificial metallic anodes to induce a corrosion-reversing flow of DC current onto the underground structure by either galvanic activity or by using impressed current.

The sacrificial anode is a metal/alloy anode (electrochemically more active than the structure) buried in the same underground environment and connected to the structure. The more electronegative anode corrodes as current leaves it and travels through the soil to the less electronegative steel structure. While this system is functioning, corrosion of the structure is effectively prevented.

In the impressed current system, an external DC power source increases the electronegativity of the anode bed from which flows a current to the less electronegative steel structure. While this system is functioning, corrosion of the structure is effectively prevented. The DC power source transmits the current through expendable anodes. They corrode through this process and must be replaced.

5.3.3.2 Protective Coatings

The primary purpose of the protective coatings program is to separate the metal structure from the surrounding electrochemical environment. Along with the necessity to maintain this type of protective coatings program, the program engineer needs to maintain and manage a general protective coatings plan for all base structures.

Environmental alteration is a less-common corrosion control method used throughout the Air Force. This method alters the electrochemical environment by changing temperature and water levels by adding corrosion inhibitors or chemical catalysts to prevent/retard the corrosion.

Inventory System — Spreadsheets and maps, Base Comprehensive Plan, cathodic protection system map and utilities maps, and cathodic Protection Annual Performance Booklet.

Assessment Methodology — WIMS reports on age and problems, utility system leak history records, periodic cathodic protection system reports, contract (for specialized tests), and AFCESA Corrosion Analysis Team who will perform comprehensive surveys and reports.

References — ETL 91-6, *Cathodic Protection*; MIL HDBK 1004/10, *Electrical Engineering Cathodic Protection*; MIL HDBK 1110/1, *Paints and Protective Coatings*; AFM 85-5, *Painting of Air Force Facilities* (to be replaced with MIL HDBK 1136); ETL 86-4, *Paints and Protective Coatings*; and AFI 32-1054, *Corrosion Control*.

5.3.4 Industrial Water Treatment

The opposite electrochemical effect on heat transfer systems is scale buildup. This buildup normally occurs in systems using heated water or steam (e.g., boilers, heat exchangers, hot water piping, cooling towers). Scale causes significant heat transfer efficiency losses in the heating systems and can result in overheating, stress, and deterioration of the systems. IWT combats this scale buildup by treating the industrial water with scale inhibitors or chemicals to react with the scaling compounds. A buildup of the scale is usually removed with acidic washes and/or physical chipping. The industrial water treatment program engineer manages the treatment systems and scale removal.

Inventory System — Spreadsheets and maps.

Assessment Methodology — WIMS reports on age and problems, periodic inspections of the systems, energy usage reports, and contract (for specialized tests).

References — AFP 91-41, *Industrial Water Treatment Procedures*.

5.4 General Programs

5.4.1 Energy Management

Energy management is one of the largest and most regulated programs in Maintenance Engineering. It encompasses all those efforts required to meet the Energy Policy Act of 1992, the Executive Order 12903, and the Federal Energy Management Improvement Act of 1988. The federal energy program requires all installations to have plans to meet specific energy reductions, measured in consumed British Thermal Units (BTU's) from a 1985 baseline, by specific target dates. This program requires the energy management program engineer to maintain a comprehensive 1985 baseline survey. The survey includes energy usage at all levels and a square-footage analysis of the base. The engineer prepares annual reports on energy usage and the reduction compared to the baseline and a detailed plan to further reduce the usage. This plan should include:

(1) facility upgrades;
(2) EMCS or DDC system upgrades;
(3) a list of energy opportunities through maintenance, repair, or minor construction activities; and
(4) a base education/awareness program.

NOTE

This program is both mechanical and electrical in focus and may fall upon either engineering discipline depending upon the manning, talents, and skills available at each base. Frequently, the engineer who manages the energy management program also manages the base utilities.

Inventory System — 1985 Energy Analysis and annual consumption reports.

Assessment Methodology — WIMS reports on age and problems; utilities rates, energy usage reports; periodic inspections of critical systems; and contract, comprehensive energy opportunity analysis.

Energy Projects — The Maintenance Engineer should consider opportunities for energy projects including the Energy Conservation Investment Program (ECIP), Federal Energy Management Program (FEMP), and Energy Savings and Performance Contracts (ESPC). Opportunities also exist at some locations for energy projects through demand side management (DSM) agreements with the local utility company. These programs should be coordinated with the Air Force Energy Manager, HQ AFCESA/CESE, 139 Barnes Drive, Tyndall AFB FL 32403-5319, DSN 523-6217.

References — FAR PART 41; DFAR 241; AFI 32-1061, *Providing Utilities to US Air Force Installations*; ETL 83-9, *Insulation*; ETL 84-7, *MCP Energy Conservation Investment Program (ECIP)*; ETL 86-5, *Fuels Use Criteria for AF Construction*; ETL 94-2, *Utility Meters in New and Renovated Facilities*; ETL 94-4, *Energy Usage Criteria for*

Facilities in the Military Construction Program; AFEPPM 86-1, *Energy Management - Goals*; AFEPPM 86-2, *Energy Management Monetary Awards Program*; AFEPPM 86-3, *Energy Efficiency in Existing Facilities*; AFEPPM 86-4, *Energy Efficiency in New Facilities*; AFEPPM 86-5, *Energy Efficiency in General Operation Facilities*; AFEPPM 86-6, *Facility Energy Conversion*; AFEPPM 86-7, *Facility Energy Metering*; AFEPPM 88-1, *Defense Energy Information System - Utility Energy Report*; AFEPPM 86-11, *Third Party Financing in the Facility Energy Program*; AFEPPM 86-13, *Shared Investments in the Facility Energy Program*; AFEPPM 86-14, *Energy Security in Air Force Facilities*; AFEPPM 86-16, *Building Energy Technical Surveys*; AFEPPM 88-6, *Programming Facility Energy Efficiency Requirements*; AFEPPM 88-7, *Energy Conservation Investment Program Projects*; AFEPPM 88-8, *Building Temperature Standards*; AFEPPM 88-9, *Facility Energy Life Cycle Cost Analysis*; AFEPPM 88-10, *Equipment Energy Efficiency*; AFEPPM 88-11, *Air Force Energy Plan - Facility Energy Portion*; AFEPPM 90-2, *Facility Energy Program Reporting*; DEPPM 91-2, *Implementing Defense Energy Management Goals*; DEPPM 91-3, *Waste-To-Energy Projects*; DEPPM 93-1, *Centralized Competitive Acquisition Of Direct Supply Natural Gas*; AFEPPM 94-1, *Implementation Plan for Participation in Utility Sponsored Programs Energy Conservation/Demand Site Management*; and DoD Directive 4140.25-M, *Management of Bulk Petroleum Products, Storage, and Distribution Facilities*.

5.4.2 Utilities Management

Utilities contracts require special technical skills of a program engineer. The engineer must be able to:

(1) analyze various utility requirements and options of the base systems and

(2) access the utility supplier’s ability to develop an energy-efficient, low-cost utility package.

Utilities management and energy management are closely related and frequently assigned to the same engineer. Utilities contracts and management are further discussed later in this volume.

5.4.3 Facility Investment Metric (FIM)

The Facility Investment Metric program assesses the quality of the structure in support of the mission based on measurement of specific requirements. While the program has useful criteria for evaluating needs, the criteria does not attempt to assess building systems or infrastructure systems. FIM is usually managed by the CEC programming office. The key to a successful total infrastructure program is taking the FIM results and matching them to the technical evaluations of the infrastructure. The method to do this must meet installation mission requirements and protect the infrastructure integrity. This results in the protection of the installation mission requirements.

5.4.4 Informal Programs

Many bases have small, informal programs to support base-specific concerns and initiatives. These programs are rarely regulated, but require some expert management. Most are managed either with a series of folders or a marked-up map and, rarely, supported with spreadsheets.

Other systems included in the general program are quality of life; natural systems, grounds and landscaping, painting, environmental concerns, and aircraft arresting barriers.

Most bases have a goal to apply a portion of their O&M funds to quality of life projects. These projects usually are high visibility architectural and interior design efforts. Having a priority for these projects and their execution will enhance advocacy for critical areas.

As with quality of life, grounds and landscaping projects are high visibility projects that require expert handling to ensure satisfactory attention to command interests.

Painting is often separated from the corrosion control program. The painting program involves all above-surface protective coatings and is usually managed by a civil engineer or technician.

Various environmental concerns involving underground and above ground storage tanks, oil/water separators, recycling contracts, etc. require an operations point-of-contact and often an inventory, assessment, and improvement plan. A mechanical engineer or technician often manages these activities.

Aircraft arresting barriers systems are maintained and managed in the power production work center. They often require an engineer point-of-contact to provide liaison with base, MAJCOM, and Air Staff leadership and advocate for program funds.

Chapter 6 Non-design Drafting

Maintenance Engineering is responsible for non-design drafting support. This includes maintaining facility as-built drawings, Base Comprehensive Plan (BCP) drawings (tabs), and non-design production, repair, and maintenance of drawings.

NOTE

Engineering Flight often retains ownership of the vault or assumes shared responsibilities with Maintenance Engineering. Engineering Flight is responsible for the management of the BCP.

6.1 As-builts

Every utility system and each individual facility should have at least one set of as-builts maintained by CE. These drawings are usually stored in a drawing vault. As-builts document the as-constructed facility and should account for all changes to date. As changes occur, red-line drawings (so-called, because changes to the sheets are frequently in red lines) are delivered to the Maintenance Engineering drafting section. They are responsible for updating the master copies.

As the bases convert to a CADD or graphic information system (GIS) drawing environment, so should their as-builts. The Maintenance Engineering drafting section will use the red-line drawings to update the CADD masters.

6.2 Base General Plan Tabs

The Base General Plan tabs include the base infrastructure (e.g., power, gas, water, and sewer lines) from the as-is standpoint with future planned improvements in overlays. The Maintenance Engineering drafting section uses red-line drawings from work center and contract projects to update these plans. As bases convert to a CADD/GIS environment, they are commissioning new Base General Plans in CADD/GIS format. The maintenance of infrastructure tabs requires Maintenance Engineering to use the red-line drawings to update the CADD masters.

6.2.1 Reproduction and Non-design Production, Maintenance, and Repair of Drawings

With ownership of the as-builts comes the responsibility to produce copies of the as-builts as needed to support the mission. Reproduction may be needed for the damage control center during base recovery or for A&E firms at the beginning of facility design contracts. Examples of drawings not related to project design include maps for service contracts, sketches to support the operations flight mission, and CE readiness drawings (for recovery plans).

NOTE

Service contract QAEs are typically of the engineering AFS and should have drafting in their position description. QAEs should be able to prepare their own contract maps depending on workload and the availability of equipment and space.

6.3 Major Updates and Conversions

The operations tempo and the construction funding levels during recent years have resulted in most base infrastructure changes outpacing the maintenance of the BCP tabs and as-builts. The Maintenance Engineer often faces an out-of-date set of drawings which must be brought up-to-date during high operations tempo, construction funding, and reduced manning.

The Maintenance Engineering Element’s manning was predicated upon maintenance of the drawings, not reconstructing or redrafting them. As such, attempting to update the drawings or convert them to CADD in-house has proven to be too labor intensive. Up to three months’ time may be required for a dedicated draftsman to update one complex facility in CADD. The Chief of Operations and the Maintenance Engineer should meet with the Chief of Engineering, the Chief of Design, and/or the non-commissioned officer in charge (NCOIC) of Site Development to discuss opportunities to pool drafting resources.

Another solution is to contract as-built and BCP tab conversions, updates, and maintenance. This option may accommodate a mission that a Maintenance Engineering section may not be in a position to perform adequately. A service contract could accommodate as-builts and/or BCP tab maintenance and relieve the engineering draftsmen to dedicate man-hours to QAE or other non-design drafting duties. An IDIQ contract (or portion of a service contract) allows for conversion of a facility to CADD/GIS or update of an outdated drawing when funding becomes available. Finally, an A&E contract to convert for CADD/GIS conversion of a block of infrastructure or facilities go far to advance the state of the drawings.

Most infrastructure work centers maintain their own set of as-builts. The work centers typically have the greatest need for accurate drawings and, typically, have the most accurate information. In some instances, the work centers have an individual dedicated to maintaining these drawings. Teaching this individual the CADD skills necessary to convert and maintain the drawings on CADD is all that is needed to enable the work center to serve both the CE unit and the work centers.

Chapter 7 Perform Inspections for Service, Utility, and IDIQ Contracts

7.1 Inspection Responsibilities

AFMS places all recurring and non-recurring service and utility contract support (specification, contract negotiation support, and quality assurance) under Maintenance Engineering. Contracts are a major force multiplier to meeting mission needs. Maintenance Engineering develops the statement of work (SOW) for all requirements generated by the Operations Flight, with the exception of O&M and MILCON projects. To perform the necessary inspections to support these contracts, the Facility Maintenance Elements may need to augment Maintenance Engineering to providing some level of manpower and skill levels to adequately perform the inspections.

7.2 Service Contracts

Service contracts are defined by the FAR (37.101) as a "...contract that directly engages the time and effort of a contractor whose primary purpose is to perform an identifiable task rather than to furnish an end item of supply." The sole purpose of the contract is for the contractor to perform some specified quantity of work.

In a recurring services support contract, the quantities of work are known and recur periodically, the contractor is paid periodically, and typically the contract is awarded annually with option year(s). Examples are grass cutting, refuse collection, and floor sweeping.

Non-recurring work quantities are unique and specific to the time at which they are required; but, otherwise fall under the service contract definition. These services involve payment upon completion of the service and should be contracted individually as required. These services are often indefinite quantity, indefinite delivery line items in recurring services contracts. Examples are tree repair, storm cleanup, and carpet cleaning/shampooing.

The FAR also discusses the difference between Personal and Non-Personal Services Contracts. Personal services contracts are *forbidden* for CE functions. In this type of contract, the contractor personnel appear to be government employees under the direct supervision of government employees.

7.2.1 Non-personal Services Contract

In a non-personal services contract, the contractor personnel are not under the supervision and control experienced by government employees. In this type of contract, the personnel serve under the terms of the contract, which states the work tasks, frequency, quality, and timing of services. This type of contract is used for CE services.

Non-personal services contracts are used because one QAE and $400,000 in service contracts can help offset the workload of approximately ten people. This allows the BCE to more effectively concentrate the limited workforce on work which is, inherently, a government function. Service contracts can be used for:

(1) testing, maintenance, overhaul, repair, or servicing of supplies, systems, and equipment;
(2) routine recurring maintenance;
(3) housekeeping and base services;
(4) advisory and assistance; and
(5) operation of government facilities, equipment, and systems.

Service contracts are a good avenue for performing the recurring work program items that unique mission requirements have tabled.

Many service contracts are standard across the Air Force and may include:

(1) grounds maintenance contracts;
(2) custodial contracts;
(3) refuse contracts;
(4) COCESS contracts (managed by Material Acquisition), and
(5) housing maintenance contracts (managed by housing).

Service contracts provide a good means for execution of recurring portions of the mission that no longer can be accomplished in a unit of reduced manning. Examples of common smaller service contracts are elevator maintenance contract; cranes and hoists maintenance contract; oil water separator inspection maintenance and cleaning contracts; underground and above ground storage tank inspection, testing, and maintenance contracts. Ultimately, a contract for any CE service can be used provided it:

(1) does not contract for an inherently governmental function, and

(2) does not duplicate the abilities of the workforce without pursuit of A-76 actions (work that cannot be currently performed, but the workforce's duties).

To write a services contract, consult AFMAN 64-108, *Service Contracts*, which details the requirements of service contracts. A quality service contract consists of a well-written performance work statement (PWS) and a quality assurance surveillance plan (QASP).

Because others will probably have previously contracted for services, MAJCOM will have standards for most basic services (grounds, refuse, custodial). MAJCOMs, AFCESA, and Air Force Institute of Technology (AFIT) have all prepared standard PWS for many service contracts and all should be considered as sources of information. Finally, contacting other base Maintenance Engineers can yield many samples of ongoing service contract PWSs and QASPs.

A PWS is a document accurately describing the essential and technical requirements for the service. It includes standards to evaluate performance requirements. The QAE, the FAC, the engineers, and the work centers must work together as a team to identify the specific requirements and evaluation standards, state them clearly and in tabular form (via the Performance Requirements Summary), and determine the relative impact of each requirement on the contract. The team must coordinate and communicate with contracting and customers to ensure acceptance of the requirements.

NOTE

AFCESA has developed a library of PWSs that are available on the internet at http://www.afcesa.af.mil /AFCESA/contracts. Additional information is available from AFCESA/CEOC, 139 Barnes Drive, Tyndall AFB (DSN 523-6372).

The QASP is an organized planning document used for quality assurance surveillance. It contains sampling guides, checklists, and decision tables. It is the government's record for all the decisions and plans supporting the Performance Requirements Summary.

The Objective Squadron sets a fixed level of QAE support for the core service contract requirements. As bases identify additional service contract requirements, this fixed level of manning does not increase. This situation may result in a QAE work overload. How the base addresses this problem is entirely dependent upon the unique manning of the organization, the special skills of the people, the mobility manning requirements, and the unit mission. However, matrix relationships have served successfully.

Maintenance Engineering is the responsible organization for CE service contracts. The QAEs of Maintenance Engineering should have the expertise and the training to be the focal points for service contracts. The work centers can also provide specific expertise in monitoring and evaluating the performance of some contracts.

EXAMPLE

It has been determined a contract is needed to provide oil/water separator maintenance and cleaning. This ensures the water work center can continue to meet the water operations mission. A Maintenance Engineering QAE will be appointed to manage the contract documentation and provide the official contracting interface. Water work center personnel will be appointed as alternate QAEs for the purposes of conducting the inspections and documenting contractor performance. This relationship continues work center involvement and alleviates the manning problems of the mission.

7.2.2 Contractor Relationship

The relationship developed with the contractor determines the level of performance received. The contract relationship is long-term, at least one year with option years. If in the first months of the contract, the contractor is hit hard with contract deficiency reports (CDRs), the risk of alienating the contractor and developing an adversarial relationship is possible. On the other hand, failure to respond to unacceptable performance runs the risk of establishing a precedent for accepting substandard performance. Frequent meetings early in the contract to discuss performance and schedules (include the contracting officer) will go far to establishing good working conditions and building relationships that satisfy both parties.

In general, special requests undermine service contracts. Anticipated special requests can be accommodated as IDIQ line items. AF Form 9 modifications can accommodate special requests when they are unforeseen. The extra time taken in managing the requests will pay dividends with a satisfied contractor and an enforceable contract.

7.2.3 Requirements Analysis

Application of sound management principles in analyzing contract requirements is essential to overseeing contracts. It also ensures dollars are not needlessly spent. An example of applying these principles follows.

The validation of the actual square footage of a facility under custodial contract saved one base $120,000 in one year. Often base maps and facility maps may be inaccurate. The QAEs and engineers should use available time to validate square footage. The assumption all offices are 120 square feet, when they actually are 112 square feet, when multiplied by the number of facilities and office spaces, results in increased costs and an impact on real property.

Service contract references which may be of help in writing and administering contracts are:

(1) AFMAN 64-108, Service Contracts;
(2) AFPD 63-5, *Quality Assurance*;
(3) AFPAM 32-1006 (draft), *Service Contract Guide for Civil Engineers*;
(4) AFCESA/CEOC, 139 Barnes Drive, Tyndall AFB; and
(5) http://www.afcesa.af.mil/AFCESA/contracts.

7.3 Utility Contracts

A utility service contract is defined by the Federal Acquisition Regulation (FAR), 41.101, as a "...service such as furnishing electricity, natural or manufactured gas, water, sewerage, thermal energy, chilled water, steam, hot water or high temperature water." In this respect, the contractor provides some product on a continuous basis of a quantity that is, by nature, indeterminate until the moment of actual need.

The following are not considered utility services:

(1) refuse collection, snow removal, and other on-call services, unless not subject to the Service Contract Act of 1965;
(2) cable television and telecommunications services [(see AFI 64-101, *Cable Television (CATV) Systems on US Air Force Installations* and AFI 33-111, *Telephone Systems Management*)]; and
(3) acquisition of natural or manufactured gas as a commodity.

However, the Air Force may sell refuse collection and disposal, snow removal services, and fuels under utility sales contracts and agreements.

The Base Civil Engineer appoints a focal point for coordinating all activities required to purchase, sell, and manage utilities. This focal point is usually an engineer in Maintenance Engineering, although a QAE may be valuable to support the contract management activities.

The Maintenance Engineering focal point is responsible for managing the utility bill which includes ensuring the service is reliable, the base is on the best rate, monthly validation of the utility bills, proper billing of resale customers, accurately reporting consumption and cost data, and monitoring the utility companies for rate increases. As much as thirty percent of the total base civil engineer O&M budget may be used to pay the utility bill. Frequently, any savings or cost avoidance that Maintenance Engineering can realize for the base in utility dollars may be used by the base as discretionary funds.

Activities involved in purchasing, selling, and managing utilities is detailed in AFI 32-1061, *Providing Utilities to U.S. Air Force Installations*. The following responsibilities fall under the utility focal point:

(1) estimating utility requirements and preparing utility service specifications for facilities with large loads and deciding which is the most economical and feasible;
(2) managing technical aspects of utility services;
(3) making recommendations on technical sufficiency and acceptability of proposed rates, charges, and provisions;
(4) using load management technology and devices to manage loads, including shifting loads off-peak and developing (in conjunction with the BCE and installation commander) a load management plan;
(5) budgeting for utility services and manages funds;
(6) coordinating with MAJCOMs on any proposed rate changes;
(7) supplying utilities and services to all authorized purchasers, computing utility sales rates, and preparing and administering all utility sales contracts/agreements; and
(8) maintaining utility management brochures for each supplier.

To oversee the utilities contracts program, the maintenance engineer should verify the above responsibilities and ensure the utilities engineer maintains documentation on each. As an example, the maintenance engineer may prepare draft utilities brochures for each alternative method to obtain utility services. These drafts would provide an overview of the method, source, costs, contract characteristics, and a discussion of why a source is not used.

AFI 32-1061, *Providing Utilities to U.S. Air Force Installations*, AFCESA/ CESE, 139 Barnes Drive, Tyndall AFB provides assistance in writing and managing a utilities contract.

7.4 IDIQ Contracts

An indefinite delivery/indefinite quantity contract is also known as a delivery order contract. It is a method of contracting (just as firm fixed-price is a method) and can apply to a construction, service, utility, or commodities contract. Governed by FAR 16.504, an IDIQ contract identifies work items to be bid as pre-priced within the period of the contract (usually by the year). The contract dictates the price of these items and the performance standards. However, the quantity of the required work is not determined (beyond some minimum).

This contract allows the base to identify a generic recurring requirement (e.g., empty an eight cubic yard dumpster, paint wall by square foot, replace asphalt pavement) for execution at a later date when work is funded and required.

An IDIQ service is essentially a non-recurring service. However, rather than contract the service with multiple, individual contracts, CE can decide to contract IDIQ. Most service contracts involve some sort of IDIQ requirement. For example, a grounds contract may have a special events requirement that identifies the scope and timeline involved with preparation of some grounds for a special event. In this case, as special events occur throughout the year, the contractor is paid the pre-bid price for the preparations. Other examples include tree-doctoring, on-call refuse collection, special event portable potties, and carpet shampooing on custodial contracts.

In the case of IDIQ services (even for a service that is entirely IDIQ), Maintenance Engineering is responsible for developing the contracts, supporting contracting throughout the negotiations, and providing QAE services for the contracts.

Construction IDIQ contracts are becoming more and more common as CE seeks to identify avenues to maintain base and MAJCOM standards. One such contract is Simplified Acquisition of Base Engineering Requirements. SABER contracts fulfill facility minor construction and repair and, often, replace small construction contracts. As a construction contract, SABER is typically managed by the Engineering Flight.

7.4.1.1 Infrastructure

Other construction IDIQ contracts involve infrastructure such as pavements, railroads, signs, roofing, electrical distribution systems, or heating, ventilation, and air conditioning. Maintenance Engineering is responsible for this infrastructure in managing programs, the five-year plans, the work requirements, and the current state. Maintenance Engineering works with the Engineering Flight to successfully manage infrastructure construction IDIQ contracts.

NOTE

The specific division of responsibilities is a factor of the unit manning, individual talents and skills, and base mission.

As IDIQ contracts become more and more common, their usefulness in executing infrastructure program requirements is growing more and more apparent. Infrastructure programs that typically fare poorly in annual funding (e.g., roofing) can posture themselves for windfalls in late year fallout funds due to the ease of IDIQ contract obligations.

An IDIQ itemizes quantities of work: $___ per square foot of latex, x.x mil thick, paint or $___ per square yard of 6-inch thick, welded-wire mesh reinforced, 3000 lb. air-entrained concrete.

The contractor bids on the line item values of the contract.

Because most types of IDIQs have been previously contracted, MAJCOM may have standards for most basic IDIQs (pavements, paint, roofs). MAJCOMs, AFCESA, and AFIT have all prepared standard Performance Work Statements for many IDIQ contracts. Finally, contacting other base Maintenance Engineers can yield many samples.

Information on IDIQ contracts may be obtained from AFCESA/ CEOC, 139 Barnes Drive, Tyndall AFB.

Chapter 8 Recurring Work Program Support

8.1 Recurring Work Program

The recurring work program is a mission shared by all sections in the Operations Flight, including Maintenance Engineering. The work centers manage and execute the day-to-day program. Material Acquisition maintains the appropriate stock, either in the CE supply store or forward stores/work center stocks, to support the program. Maintenance Engineering oversees the development of the program, periodically reviews the requirements, and makes recommendations to improve the infrastructure and the manpower usage.

The recurring work program applies to all routine, redundant, recurring work involving real property, real property installed equipment (RPIE), or systems and other equipment maintained by CE. By definition, its scope and frequency is well known, locations are well established, and materials are available or not required. Recurring work includes operations, service work, and preventive maintenance for which the scope and level of effort is known without a prior visit to the job site each time the work is scheduled. Some RWP will be service or operations related: flightline sweeping or snow-removal are services provided by the horizontal work center of the Heavy Repair Element and are typically work items in the RWP. However, most RWP will be preventive maintenance work; for example, replacing the belts on HVAC equipment on a periodic basis. This type of RWP requires Maintenance Engineering analysis support.

8.2 Preventive vs. Breakdown Maintenance

The challenge is to evaluate the long-term costs associated with preventive maintenance (PM) schedules compared to the replacement costs of not performing maintenance and resulting breakdown. Often, inexpensive, non-critical items such as pumps or motors can be replaced at a cheaper cost than the long-term preventive maintenance costs to extend their life. However, downtime of some mission-critical HVAC equipment could cost the government not only the replacement cost of an expensive HVAC component, but also the downtime of the mission, and, potentially, critical equipment in the facility. The engineer is tasked to strike a balance between appropriate preventive maintenance and acceptable breakdown costs.

8.2.1 Life-cycle Cost Analysis Method

One method to evaluate preventive maintenance versus breakdown maintenance is life-cycle cost analysis. To perform the analysis:

(1) Identify the estimated lifespan and/or the impact to efficiency of the item at each proposed maintenance level.
(2) Identify the replacement cost of the item.
(3) Identify the cost of breakdown maintenance. Include the costs to repair or replace the item, the impact to the mission (downtime), and the damage to affected equipment due to the breakdown. Use engineering economic analysis to convert the cost of each estimated lifespan to current costs (Present Worth).
(4) Identify the cost of the proposed level of maintenance. Note that the proposed level of maintenance may increase as the item ages. Forecast non-breakdown repairs and add these costs to the annual cost of maintenance. Use engineering economic analysis to convert these costs into a current cost (Present Worth).
(5) Add the costs of each proposed level of maintenance with their associated breakdown costs. These costs should all be on a current cost basis.
(6) Choose the lowest cost option.

The estimated lifespan and efficiency data is usually provided by the manufacturer, but at a very conservative level and normally only available at the designed preventive maintenance level. Suppliers of larger systems often provide more comprehensive technical manuals with better data. These manuals usually provide an evaluation of the data and a recommended preventive maintenance schedule. Other sources of this data are consumer reports, historic records (including electrical metering, run-time, flow rates, work orders, service calls), expert experience (work center craftsmen, local contractors, or the engineer), and design considerations. These sources may be subjective or non-specific to the brand and model in question. However, a rough order of magnitude will provide adequate evaluation criteria for a cost analysis.

The following is a sample cost analysis:

RWP Item: *Lube Sewage Lift Station Pump Motor*

Item Replacement Cost: $1000 - installed price.

Item Breakdown Repair/Rebuild Cost: $1200.

NOTE

Cost dictates repair by replacement at $1000.

Presume annual inflation cost of three percent.

Cost of RWP PM item per occurrence: $25 (one hour).

Presume straight-line depreciation and $0 salvage value.

NOTE

All costs are current costs. If engineering economic analysis formulas are used to determine future and annual cost increases, and then converted into present costs, they would be the same costs as they are now. No formulas in this case need be pursued.

Level of Maint	**Frequency of Failure**	**Avg Level Efficiency**	**Annual PM Cost**	**Ann. Ops Cost**	**PC of Repair**	**PC of Ops Cost**	**PC of PM**	**Total PC of Option**
Monthly	15 years	90%	$ 300	$30.00	$1000.00	$450.00	$ 4500	$5950.00
Quarterly	14 years	80%	$ 100	$33.75	$1066.67	$506.25	$ 1500	$3072.92
Annually	10 years	60%	$ 25	$45.00	$2000.00	$675.00	$ 375	$3050.00
Never	5 years	50%	$ 0	$54.00	$3000.00	$810.00	$ 0	$3810.00

(1) Frequency of failure and efficiency curves are to be researched using previously cited resources.

(2) Average level of efficiency is an average of the efficiency curves dependent upon a level of maintenance. Actual efficiency will decrease in a curve. For greater accuracy, this decrease can be individually priced per year; however, the average provides a rough order of magnitude.

(3) Annual operations cost is the energy cost of operating at the prescribed efficiency to meet a level of performance required. If 90% efficiency is the designed efficiency at $30/year, then other costs = (90 * 30)/(efficiency).

(4) Present Cost (PC) of Repair = $1000 * # replacements over 15 years (1 1/15th replacement for 14-year replacement)

(5) Present Cost of Ops Cost = Annual Ops Cost * 15 years

(6) Present Cost of PM = Annual PM Cost * 15 years

(7) Total = PC's of Repair + Ops Cost + PM Cost

From the sample it can be learned:

(1) The life-cycle cost of preventive maintenance can often be much higher than the replacement value of the item, even for a one-hour job.
(2) Preventive maintenance could well be economically unsound with less expensive items (e.g., a $150 motor).
(3) The additional cost of a zero-maintenance item (such as a motor with sealed bearings requiring no lubing) may well be less than the cost of PM on a cheaper item. In the above example, a $2500 no-maintenance motor at 90% efficiency would be less expensive in the long run than the $1000 motor with $25 periodic maintenance.

8.2.2 Alternative Analyses

Life-cycle cost analysis is valuable for large items of critical value to a facility. However, researching and analyzing the thousands of RWP PM items that bases perform requires more manpower than available. The following two methods are more practical, more subjective (on the part of experts), but quicker and more efficient with small items. RWP Requirement Elimination involves reviewing the list of RWP items and identifying those that can be eliminated:

(1) due to the very low replacement cost of the item (e.g., all items under $100) and non-mission criticality;
(2) by replacing with zero-maintenance components; and
(3) by contracting out the requirement to a service contractor.

This evaluation needs to be made by the team of the program engineers, the work center chief(s), and appropriate senior craftsmen and superintendents. Often, evaluation of the cost impact is through estimates based upon experience. While these estimates are more subjective than the cost analysis method, this method can analyze many more systems and components in a shorter time and the accuracy is close enough to evaluate the smaller, less-critical components.

Another method for analyzing remaining RWP items is the man-hour ceiling/priority analysis method (MAPCO).

Most work centers have a limited number of man-hours — a ceiling — that will not increase, no matter how cost-effective RWP or other work items become. As a result, a manager may budget a portion of the man-hours to RWP and then perform the RWP priorities that budget allows.

RWP should be executed, whenever possible, in conjunction with a facility visit (such as 1219-type work). When the work is scheduled, WIMS can generate a listing of RWP for that facility throughout the period between the visit and the next programmed visit. This listing will include the mandatory requirements followed by the non-mandatory requirements. As the crafts pursue the 1219 Direct Scheduled Work and Maintenance Action Sheet requirements, they complete all mandatory RWP items. At the end of the visit, if additional man-hours are available in the schedule, they can begin to complete the non-mandatory items in priority order.

Many bases have difficulty in meeting the RWP requirements due to the limitations of reduced manpower, requirements for direct scheduled work and work orders, and the mission requirements (e.g., readiness and training). An opportunity to meet critical RWP requirements with minimal impact on unit manpower is through service contracts. Program engineers, work center chiefs, and senior craftsmen should be on the lookout for opportunities to contract redundant, manpower intensive, critical RWP requirements.

NOTE

The scope, frequency, locations, and materials for RWP is known. The only questions should be the availability of funds, the availability of work center man-hours, and cost effectiveness.

The Maintenance Engineers and responsible work centers must mutually agree on the management of the service contracts. The team approach is the best method to accommodate the new QAE requirements while ensuring work center oversight of the requirement.

Faced with reduced manpower and the requirement to provide RWP analysis support, engineers can have a better perspective of the work by visiting one RWP preventive maintenance job in their discipline per day. The goal should be to complete the program in one year. To do this, the engineers would review the next week's 1219/RWP schedule and coordinate visits with the work centers. On the job site, they review the job's frequency and methods and validate the requirement.

The benefits from this program are optimizing the program while tackling it one step at a time, improving engineer and work center coordination, and increasing engineer exposure to the infrastructure environment.

Chapter 9 Work Analysis/Methods Improvement

9.1 Objective and Performance Standards

Performance Standards and Maintenance Engineering is responsible for analyzing the Operations Flight resources and mission requirements. Recommendations are provided to the flight chief and element superintendents on resource allocation and work execution. These analyses include:

(1) developing performance standards;
(2) economic or cost/benefit analyses;
(3) developing and measuring productivity and quality force indicators; and
(4) review of work center workload, manpower balance, and skills mix.

The function should result in a workforce that works smarter, not harder.

Performance standards are a necessary part of managing a base's infrastructure. In addition, they provide guidance on methods improvement to the work centers. Program engineers should monitor the work center actions that are necessary for successful management of their infrastructure programs. They should then document these actions in checklists, guides, specifications, handbooks, drawings, or in-house operating instructions to provide guidance to the work centers and standardize performance. A methods improvement that will save the Operations Flight funds or man-hours, should be documented in a performance standard to provide a road map for successful implementation of the improvement. Performance standards completely coordinated with all parties involved and the final document passed through the chain of command.

9.2 Economic or Cost/Benefit Analyses

Evaluations of all processes and methods require some sort of analysis of alternatives. In most cases, indicators of quality or productivity include some measures such as man-hours used, cycle time, accuracy, efficiency, effectiveness, and productivity. Comparing one alternative with high accuracy but low efficiency to another alternative with low accuracy but high efficiency is difficult without some common measure of merit. Industry has long used cost as the measure of merit. Economic or cost/benefit analysis involves converting all characteristics of an alternative to cost factors and comparing the costs to support or identify a solution. DoD uses lowest life-cycle cost as a primary design criteria

9.2.1 Formal Economic Analysis

Formal methods for economic analyses are detailed in: AFPD 65-5, *Cost and Economics*; AFI 65-501, *Economic Analysis and Program Management*; AFI 65-502, *Inflation*; AFI 65-503, *USAF Cost and Planning Factors*; AFI 65-504, *Independent Review of Commercial Activity Cost Comparisons*; and AFMAN 65-506, *Economic Analysis and Program Management*.

9.2.2 Informal Cost/Benefit Analysis

As discussed in Chapter 8, formal economic analysis is often too detailed and time consuming for day-to-day decisions on routine methods, processes, and resources. Once engineers master the concepts of economic analysis, they should become proficient in preparing brief, informal cost/benefit analyses (CBAs). These analyses are less detailed and based upon readily available data. This is often less complete or objective than acceptable in formal economic analysis. An example of an informal cost/benefit analysis is provided in Chapter 8.

General cost/benefit analysis procedures are as follows:

(1) Convert all costs/benefits of an alternative to an equivalent dollar cost. For example, converting the efficiency of a pump to the energy cost to perform a set quantity of work.
(2) Convert all dollar costs to a common frame of reference: present worth, future worth, annual costs, etc.(standard engineering economics).
(3) Compare costs to identify the best solution.

> **NOTE**
> Some factors or measures of merit are inherently non-cost related; such as, customer satisfaction or increased readiness. The question that needs to be answered is how much does the leadership want to pay for the benefits.

9.2.2.1 Equivalent Dollar Costs

Most measures of merit can be converted to dollar equivalencies. The following are some examples of possible dollar equivalencies for non-dollar measures.

Productivity or Efficiency — This is a measure of output compared to input required. If an alternative purposes to produce more (e.g., work done) with less resources required (e.g., man-hours, equipment time, materials), then developing a cost equivalency for comparison to other alternatives is as follows:

(1) Select a set quantity of output (e.g., a given number of average direct-scheduled work orders).
(2) Convert all inputs (e.g., costs) for that set quantity to dollars. See below.

Man-hours — The Resources Flight maintains a man-hour cost factor for all grades and ranks in the unit for reimbursement purposes. These are available in WIMS. Using an average grade or rank, the cost factor will convert the man-hours to an equivalent cost.

Equipment Hours — Air Force equipment is expensive to purchase, maintain, operate, and store. Formal analyses of these costs may be derived but are impractical for informal CBAs. Calling a local equipment rental agency to identify the typical hourly cost to rent that type of equipment or use of a unit price guide such as RS Means or Dodge will provide cost factors.

Accuracy/Effectiveness — A measure of the percentage of work that falls within acceptable standards. An alternative that purposes to increase accuracy proposes to decrease the percentage of work that fails the standards. An equivalent is developed by determining the result associated with failed work, typically rework or hidden defects. Engineering judgment must be used in assessing risk due to defects and assigning costs to each. Formal risk analysis is also a tool, although probably more time consuming than this analysis can afford.

Cycle Time — This measure details the time to complete a process or method from start to conclusion. Often it represents downtime or customer impact. Downtime alone can be a complicated factor involving lost man-hours of all customer employees, idle equipment and facilities. Engineering judgment may be required to assign a cost to this factor.

Depreciation — For this level of analysis, straight-line depreciation from initial worth to salvage value is appropriate.

9.2.3 Engineering Economics

Engineering economics is an entire field of engineering cost analysis and could consume an entire volume discussing the various methods. For these purposes, a simple Net

Present Worth method is discussed. Engineering economics courses or texts can be consulted for more information.

Cost values are time based. As time passes, inflation and interest values change the worth of cost values. Comparing annual costs, rental fees, outyear contract expenditures, and today's costs requires a conversion of these costs to some frame of reference. These values are converted to a net present worth (a price in today's frame of reference).

In general, if:

F = the future worth or cost in an outyear

i = the interest rate (or inflation rate) over a period

A = a fixed cost over a number of periods (often annual)

n = the number of periods interest is compounded

Then, P (the present worth) may be computed as follows:

$$P = F * (1/(1+i)^n)$$

$$P = A * \frac{(1+i)^n - 1}{i *(1+i)^n}$$

NOTE

n must be the same for all costs evaluated to provide a common reference. Changing or variable annual costs should be converted to separate future worth for conversion back to present worth.

These values are more conveniently computed using engineering economic tables. Engineering economics texts and/or courses can be consulted.

9.3 Productivity or Quality Indicators

To monitor and evaluate trends in unit work, Maintenance Engineering is tasked to develop and manage productivity or quality indicators. Indicators provide a meaningful measure of merit for managers to identify successes to share and problems to resolve. It is likely, the Civil Engineer unit already uses a series of indicators, whether command, base, unit, or flight developed and monitored. The Maintenance Engineer is tasked to manage these indicators and monitor their results.

The Maintenance Engineer should ensure that the flight has indicators encompassing all aspects of the mission. Portions of the mission that are not monitored risk receiving less emphasis by the workforce

In January 1995, sample productivity indicators were distributed by The Air Force Civil Engineer to the commands and bases. These metrics are available on the AFCESA internet site at:

http://www.afcesa.af.mil/AFCESA/Management/

or through AFCESA/CEOM. Indicators generally develop some numerical measure of the productivity or quality of work performed (e.g., direct scheduled work orders completed per man-hours available, customer satisfaction surveys). Standing alone, these indicators mean little; however, when analyzed as a trend, they can reflect the effectiveness of various managerial efforts to increase productivity or quality. True analysis of these indicators requires statistical techniques. Consult the Air Force Engineering and Services Center (AFESC) Industrial Engineer’s Handbook, April 1991, for a discussion of these techniques.

9.4 Work center Workload, Manning, and Skills Mix Review

A continuous background concern of all Operations Flight chiefs is the need to monitor work center manning to ensure:

(1) individuals have the opportunity to rotate and obtain the proper experience in their Air Force Specialty and

(2) the work centers have the proper share of manning and skills-mix to support the workload required.

Maintenance Engineering is the flight chief’s accountant in this endeavor.

9.4.1 Rotation

The flight chief, the Maintenance Engineer (or work analysis program engineer), the element superintendents, and senior craftsmen should meet to discuss and determine a rotation policy. This policy should address the timing and frequency of rotation and rotation flow for each craft and skill level. For example, junior utilities craftsmen may need to rotate between the zones and the Heavy Repair and Infrastructure Elements on a two-year basis to gain the necessary experience. Senior craftsmen may not. Having documented this rotation policy in some standard, the Maintenance Engineer should then monitor the flight personnel, their time in position, and identify the best options for future rotations. On a periodic basis, the same group should meet to discuss executing these rotations.

9.4.2 Manning and Skills Mix

Maintenance Engineering should maintain a manning roster for each work center and element. As people arrive or depart, the Maintenance Engineer should note where disparities have occurred and bring those to the attention of the element superintendents and the flight chief. Periodically, the same group who meets about rotation should meet to discuss internal moves to abate these disparities. Additionally, the Maintenance Engineer should monitor workload to identify where increases or decreases in workload occur, whether seasonally or as a trend, and propose modifications of manning or skills mix to support these changes.

Example 1

Heating work center work is typically high in the winter while zonal air-conditioning work is typically high in the summer. A Maintenance Engineer could recommend to shift manpower between the work centers as the seasons change.

Example 2

A new composite dorm facility comes on line in Zone 1, replacing eight old facilities which are demolished. A three-month review of the workload of Zone 1 shows a reduction of RWP by ten percent, a reduction of emergencies by five percent, and a reduction of the 1219 man-hours by twelve percent. This does not mean extra man-hours, but a reduction of requirements which may still exceed man-hours available. The Maintenance Engineer should then compare these requirements to other zones to identify the fraction of manning with respect to requirements. The Maintenance Engineer could recommend a movement of manpower from Zone 1 to another.

NOTE

The Maintenance Engineer and flight chief should be aware and concerned of the effect manning reductions have on their people. When work centers develop successful methods that increase their productivity and reduce the backlog of requirements, the flight chief should consider carefully before reducing the manpower of these work centers to ensure this move is not perceived as a punishment. Rather, the flight chief should reward the work centers' initiatives and seek to share this success across the flight.

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DCS/Installations and Logistics

Attachment 1 Glossary of References and Supporting Information

References

25-4140.25-M, *Management of Bulk Petroleum Products, Storage, and Distribution Facilities.*
AFEPPM 86-1, *Energy Management - Goals*
AFEPPM 86-11, *Third Party Financing in the Facility Energy Prog*ram
AFEPPM 86-13, *Shared Investments in the Facility Energy Program*
AFEPPM 86-14, *Energy Security in Air Force Facilities*
AFEPPM 86-16, *Building Energy Technical Surveys*
AFEPPM 86-2, *Energy Management Monetary Awards Prog*
AFEPPM 86-3, *Energy Efficiency in Existing Facilities*
AFEPPM 86-4, *Energy Efficiency in New Facilities*
AFEPPM 86-5, *Energy Efficiency in General Operation Facilities*
AFEPPM 86-6, *Facility Energy Conversion*
AFEPPM 86-7, *Facility Energy Metering*
AFEPPM 88-1, *Defense Energy Information Systems - Utility Energy Report*
AFEPPM 88-10, *Equipment Energy Efficiency*
AFEPPM 88-11, *Air Force Energy Plan - Facility Energy Portion*
AFEPPM 88-6, *Programming Facility Energy Efficiency Requirements*
AFEPPM 88-7, *Energy Conservation Investment Program Projects*
AFEPPM 88-8, *Building Temperature Standards*
AFEPPM 88-9, *Facility Energy Life Cycle Cost Analysis*
AFEPPM 90-2, *Facility Energy Program Reporting*
AFEPPM 94-1, *Implementation Plan for Participating in Utility Sponsored Programs Energy Conservation/Demand Site Management*
AFI 32-1001, *Operations Management* (replaces AFI 32-1031)
AFI 32-1040, *Water Systems*
AFI 32-1051, *Roof Systems Management*
AFI 32-1061, *Providing Utilities to U.S. Air Force Installations* (replaces AFR 91-5)
AFI 32-1064, *Electrical Safe Practices* (replaces AFR 91-12)
AFI 32-1068, *Heating Systems and Unfired Pressure Vessels*
AFI 32-1080, *Electrical Power Systems* (replaces AFR 91-4 and AFI 32-1063)
AFI 32-1084, *Electrical Power Plants and Generators* (replaces AFR 91-45 and AFI 32-1062)
AFI 32-1087, *Visual Air Navigation Systems* (replaces AFI 32-1044)
AFI 32-1090, *Corrosion Control* (replaces AFI 32-1054)
AFI 33-111, *Telephone Systems Management*
AFI 64-101, *Cable Television (CATV) Systems on U.S. Air Force Installations*
AFI 65-501, *Economic Analysis and Program Management*
AFI 65-503, *USAF Cost and Planning Factors*
AFI 65-504, *Independent Review of Commercial Activity Cost Comparisons*
AFJMAN 32-1017, *Highways for National Defense* (under revision - the old AFR 75-88)
AFMAN 32-1231, *Maintenance and Repair of Surface Areas*
AFJMAN 32-1046, *Railroad Design, Construction, and Rehabilitation*
AFJMAN 32-1076, *Design Standards for Visual Air Navigation Systems*
AFJMAN 32-1078, *Electrical Work Safety*

AFJMAN 32-1079, *Maintenance and Operation of Water Supply, Treatment, and Distribution Systems*
AFJMAN 32-1080, *Electrical Power Supply and Distribution*
AFJMAN 32-1082 (replaces AFM 91-3), *Facilities Engineering, Electrical Exterior Facilities*
AFM 85-5, *Painting of Air Force Facilities* (to be replaced with MIL HDBK 1136)
AFM 88-10 V1, *Water Supply, Sources and General Considerations*
AFM 88-10 V3, *Water Supply, Water Treatment*
AFM 88-10 V5, *Water Supply, Water Distribution*
AFM 88-10 V7, *Water Supply for Special Projects*
AFM 88-11V1, *Sanitary and Industrial Wastewater Collection - Gravity Sewers and Appurtenances*
AFM 88-11V2, *Sanitary and Industrial Wastewater Collection - Pumping Stations and Force Mains*
AFM 88-11V3, *Domestic Wastewater Treatment*
AFM 88-3 CH1, *Design Criteria Load*
AFM 88-3 CH14, *Design Criteria for Facilities in Areas Subject to Typhoons and Hurricanes*
AFM 91-31, *Maintenance and Repair of Roofs*
AFM 91-33, *Maintenance of Trackage* (programmed to be replaced by AFJMAN 32-1047)
AFM 91-37, *Maintenance of Fire Protection Systems*
AFM 91-44, *Railroad Track Standards* (programmed to be replaced by AFJMAN 32-1048)
AFMAN 64-108, *Service Contracts*
AFMAN 65-506, *Economic Analysis and Program Management*
AFOSH STD 127-118, *Training Device Fire Protection*
AFP 88-40, *Sign Standards* (programmed to be AFPAM 32-1097)
AFP 91-28, *Real Property Operations and Maintenance of Airfield Visual Aid Facilities*
AFP 91-35, *Refrigeration, AC, Evaporative-Cooling, and Mechanical Ventilating Systems*
AFP 91-41, *Industrial Water Treatment Procedures*
AFPAM 32-1006 (draft), *Service Contract Guide for Civil Engineers*
AFPD 63-5, *Quality Assurance*
AFPD 65-5, *Cost and Economics*
AFR 88-22, *Structures to Resist the Effects of Accidental Explosions, Introduction*
AFR 91-26, *Operations and Maintenance of Water Systems*
AFMAN 32-1121V3 (airfields)
Analysis of Hardened Structures to Conventional Weapons Effects
Army Regulation 55-80, *Manual of Uniform Traffic Control Devices (MUTCD)*, published by Department of Transportation and obtained through the technical library using the Federal Register list of current updates
DEPPM 91-2, *Implementing Defensive Energy Management Goal*
DEPPM 91-3, *Waste-To-Energy Projects*
DEPPM 93-1, *Centralized Competitive Energy Management Goal*
DFAR 241; AFI 32-1061, *Providing Utilities to US Air Force Installations*
DoD Directive 4140.25-M, *Management of Bulk Petroleum Products, Storage, and Distribution Facilities*
ETL 84-7, *MCP Energy Conservation Investment Program (ECIP)*
ETL 86-4, *Paints and Protective Coatings*
ETL 86-5, *Fuels Use Criteria for AF Construction*

ETL 86-8, *Aqueous Film Forming Foam Waste Discharge Retention and Disposal*
ETL 87-1, *Lead Ban Requirements of Drinking Water*
ETL 88-6, *Heat Distribution Systems Outside of Building*
ETL 90-1, *Built-Up-Roof Repair/Replacement Guide Specifications*
ETL 90-10, *Commissioning of Heating, Ventilating, and Air Conditioning (HVAC) systems Guide Specification*
ETL 90-8, *Guide Specification for EPDM Roofing*
ETL 90-9, *Fire Protection Engineering Criteria for Aircraft Maintenance, Servicing, and Storage Facilities*
ETL 91-1, *Fire Protection Engineering Criteria Testing Halon Fire Suppression Systems*
ETL 91-6, *Cathodic Protection*
ETL 93-4, *Fire Protection Engineering Criteria - Automatic Sprinkler Systems in Military Family Housing (MFH)*
ETL 93-5, *Fire Protection Engineering Criteria - Electronic Equipment Installations*
ETL 94-2, *Utility Meters in New and Renovated Facilities*
ETL 94-4, *Energy Usage Criteria for Facilities in the Military Construction Program*
ETL 94-5, *Fire Protection Engineering Criteria and Technical Guidance - Emergency Lighting and Marking of Exits*
ETL 94-6, *Fire Protection Engineering Criteria and Technical Guidance - Removal of Halogenated Agent Fire ETL*
ETL 95-1, *Halon 1301 Management Planning Guidelines*
FAA Advisory Circular AC 150/5340-26
FACESA Roofing Field Guides (Built-Up, Single-Ply, and Pitched)
FAR 37.101
FAR Part 41
MIL HDBK 1004/10, *Electrical Engineering Cathodic Protection*
MIL HDBK 1008B, *Fire Protection for Facilities Engineering Design and Construction*
MILHBK 1110/1, *Paints and Protective Coatings*
NFPA 101, *National Life Safety Code*
Refrigerant Management Handbook, June-94 (published by AFCESA, contact directly for a copy)
Roofing Industry Educational Institute (RIEI), Maintenance Manual
TM 5-855-1 (programmed to be replaced with AFJMAN 32-1055, Joint Services Manual for the Design)
TM-5-623 (roads)

Abbreviations and Acronyms

3E5X1	the engineering AFS
A/C	air conditioning
A-76 Action	Process, under OMB Circular A-76, under which core responsibilities are contracted
AAFES	Army and Air Force Exchange Service
A&E	architect and Engineer - most commonly referring to the contract firms
ABO	air base operability
ACES	Automated Civil Engineer System
ADD	agreed delivery data

AF/CE	Air Force/Civil Engineer
AFCESA	Air Force Civil Engineer Support Agency, Tyndall AFB FL
AFFF	Aqueous film forming foam - the fire-fighting agent often used in hanger systems
AFI	Air Force Instruction
AFIT	Air Force Institute of Technology, Wright Patterson AFB OH
AFMAN	Air Force Manuals
AFMS	Air Force Manpower Standard
AFO	Accounting & Finance Office
AFP	Air Force Pamphlets
AFS	Air Force specialty (formally called AFSC - AFS Code)
AKA	also known as
BBE or BEE	Base Bio-Environmental Engineer
BCAS	Base Contracting Acquisition System
BCE	Base Civil Engineer
BCP	Base Comprehensive Plan (replaced by the Base General Plan)
BEAMS	Base Engineer Automated Management System - an older CE database system
BPA	blanket purchase agreement
BTU	British thermal units - a measurement of energy
BUR	built-up roofing system
CA/CRL	custodial account/custody receipt listing
CADD	computer aided design and drafting, a computer-based program that organizes drafting and design functions to produce high-quality facility drawings.
CALT	contracting administrative lead-time
CAS	Condition Assessment Survey, a DoD program to objectively assess and evaluate DoD facilities for developing CAS
CATV	cable television
CBA	cost/benefit analysis
CDR	contract deficiency report, a report of substandard contract performance
CDS	career development center
CE	Civil Engineer
CEC	office symbol for the CE Engineering Flight
CEMAS	Civil Engineer Material Acquisition System
CFA	Commanders’ Facility Assessment (replaced by Facility Investment Metric)
CFETP	career field education and training plans
CIAPS	Customer Integrated Automated Procurement System
CMSgt	chief master sergeant
COCESS	Contractor Operated Civil Engineer Supply Store
CSL	CEMAS Stock List Number
CSU	customer service unit
CWM	cost work order materials
CWON	Collection Work Order Number
DC	direct current
DDC	direct digital control
DIFM	due in from maintenance
DIN	do it now

DIRK	direct input reject key
DoD	Department of Defense
DOLI	date of last inventory
DOLT	date of last transaction
DPMIAC	Defense Pest Management Information Analysis Center
DRMO	Defense Reutilization Marketing Office
DSWO	Direct Scheduled Work Order
DVEP	Disease Vector Ecology Bulletins
ECIP	Energy Conservation Investment Program
EDD	estimated delivery date
EEIC	Element Of Expense/Investment Code
EMCS	Energy Management Control System
EMIS	Environmental Management Information System
EOD	end of day
EPS	Engineering Performance Standards
ESPC	Energy Savings Performance Contract
FAD	force activity designator
FAR	federal acquisition regulations
FCA	fund cite authorization
FEDLOG	Federal Logistics Data
FEMP	Federal Energy Management Program
FIM	Facility Investment Metric
FOB	found on base
FSC	Federal Supply Class
FSDC	Fire Safety Deficiency Code
GIS	graphic information system, a linking of database data with CADD drawings
GOCESS	Government Operated Civil Engineer Supply Store
GOQ	general office quarters
GSA	General Services Administration
HM	hazardous material
HMP	Hazardous Material Pharmacy
HVAC	heating, ventilation, and air conditioning
ICS	Infrastructure condition standard
IDIQ	indefinite delivery/indefinite quantity, a type of contract
IEC	Issue Exception Code
IEU	individual equipment unit
IL	identification list
IMPAC	International Merchant Purchase Authorization Card
IPM	integrated pest management
IWT	industrial water treatment
LP	local purchase
M&R	maintenance and repair
MADJ	Adjective File
MADT	Adjective Type File
MAJCOM	Major Command
MC	minor construction

MCP	see MILCON
MCPAM	man-hour ceiling/priority analysis method to prioritize RWP work items
MCRL	master cross reference list
MDF	material documentation folder
MFH	military family housing
MILCON	Military Construction Program (previously known as MCP)
ML-C	management data listing
MNAD	Noun Additional Description File
MNON	Noun File
MRA&C	maintenance, repair, alteration, and condition
MRL	material requirements list
MRTSUD	Rejected Transaction Suspense Program
MSDS	material safety data sheet
MSYN	Noun Synonym File
MTL	master task list
NAF	non-appropriated funds
NIIN	National Item Identification Number
NIST	not-in-stock ticket
NPI	non pre-priced
NPL	non-price listed
NSN	National Stock Number
O&M	operations and maintenance
ODBC	open database connectivity, a structure enabling communications between databases
OPR	office of primary responsibility
OSD	Office of the Secretary of Defense
PCB	polychlorinated biphenyl, a hazardous additive to some oils used as coolants in transformers
PCN	Product Control Number
PD	pier delivery
PDO	Publishing Distribution Office
PFMR	Project Funds Management Record
PHM	potentially hazardous material
PIIN	Purchase Information Identification Number
PM	preventative maintenance
PMD	property movement document
PO	purchase order
POC	point of contact
POF	Purchase Order File
POL	petroleum, oil and lubricants, AF term for organizations and systems that manage any fuel or oil-based materials
PWS	performance work statement
QAE	quality assurance evaluators, QAEs monitor service contracts.
QASP	quality assurance surveillance plan
QUP	quantity unit pack
RAC	risk assessment criteria

RC	responsibility center/cost center
RCCC	Responsibility Cost Center Code
RDD	required delivery date
RFQ	request for quote
RHA	residue holding area
RIEI	Roofing Industry Educational Institute
RIF	reduction in force
RMS	recurring maintenance schedule
RPIE	real property installed equipment, equipment CE physically installs and maintains as part of a facility
RVP	reverse post
RWP	recurring work program
SABER	simplified acquisition of base engineering requirements, IDIQ contract that performs minor construction and repair.
SBSS	Standard Base Supply System
SFM	specialty function manager
SHC	self-help center
SMART	structural maintenance and repair team
SMSgt	senior master sergeant
SOQ	senior officer quarters
SOW	statement of work
SQL	structured query language, a method for communicating between databases
SSAN	Social Security Account Number
TA	Tables of Allowances
TIB	Technical information bulletins
TIN	turn-in
TLQ	temporary lodging quarter
TO	technical order
UGT	upgrade training
UJC	Urgency Justification Code
UND	urgency of need designator
URMT	utility rates management team, an AFCESA team to support base utility engineers
WIMS	Work Information Management System, the current CE database management system
WO	work order
WRRB	Work Request Review Board (also known as WORB, Work Order Review Board)

Terms

1219 visit -- The periodic facility visit performed by a zone to identify routine work requirements and schedule a follow-on repair visit by the work center crafts. Known as the 1219 visit due to the use of the AF Form 1219, Base Civil Engineer (BCE) Multi-Craft Job Order.

acquired land -- Land obtained from any private or public source other than land withdrawn from the public domain.

acquisition -- Obtain, use, or control real property or an interest in real property by purchase, condemnation, donation, exchange, leasing, revestment, or recapture.

Air Force proponents -- Air Force major command, installation, other component or other agent designated to act on behalf of the Air Force, responsible for initiating or carrying out the proposed real property acquisition.

annexation -- A procedure by which a municipality; such as a city, town, or village, incorporates Air Force land within the corporate limits of the municipality. Procedures vary depending on state law.

as-builts -- Original facility design drawings (or replacement master drawings or the master computer aided design and drafting (CADD) drawing file). Civil Engineer units use these drawings to document all as-built conditions of a facility and modifications as they occur over the years.

Base Civil Engineer -- Senior-ranking base engineer in the Civil Engineer unit.

blanket purchase agreement (BPA) -- A simplified method of filling anticipated repetitive needs for small quantities of supplies. This agreement is designed to reduce administrative cost in making small purchases by eliminating the need for issuing individual purchase documents. The government is obligated only when a call is placed against it.

blue-line drawings -- Copies of the original as-built or design drawings used for daily work.

BPA call -- An action initiated by a Civil Engineer Material Acquisition System (CEMAS) buyer or an authorized individual to order supplies from firms that have been awarded a blanket purchase agreement.

CEMAS store work order -- A special collection work order (usually work order 00011) with shop code, cost center, cost account code, and EEIC agreed upon to be used to collect the cost of material purchased and maintained in the store.

CEMAS monitor -- The chief of Material Acquisition or designated representative who will interface between Base Contracting, Base Supply, and Accounting and Finance.

CEMAS stocked items -- Items identified or approved by the chief of Material Acquisition to be stocked for recurring demands. Approval is based on demand history, funding availability, and storage limitation.

CEMAS stock list (CSL) -- A unique number assigned to individual items listed in the noun dictionary.

certificate of necessity -- A written statement, signed by Deputy Assistant Secretary of the Air Force for Installation (SAF/MII), which certifies it is necessary (for reasons vital to the national security) for the Air Force to exceed the statutory cost limits established in AFI 32-9001 relative to annual rent or alterations, improvements, and repairs to leased buildings.

cession -- Ceding or yielding by a state of its legislative jurisdiction over government-controlled real property to the federal government.

clearance easement -- The right to remove or prevent obstructions rising into the airspace. Examples are easements over areas beyond the ends of an airfield runway (approach or departure clearance zones). Also, easements adjacent to the sides of the runway (transition zones), clearance for approach lighting sites, communication sites, etc. A clearance easement, specifically, does not include the right of aircraft passage over the land, so the landowner may separately recover for loss of value to his or her land due to low and frequent flights of aircraft.

commercial facilities (industrial-type) -- Air Force-owned and -operated facilities housing a function that could be done by private industry, such as motor repair work centers, laundries, bakeries, ice cream manufacturing plants. (Exceptions are base exchanges, commissaries, and other non-appropriated fund activities.)

condemnation -- A judicial proceeding started by the government through the Department of Justice for the purpose of exercising its right of eminent domain. Condemnation results in passage of title and land to the government with or without the consent of the landowner, but with just compensation paid to him or her.

consideration -- Compensation or an equivalent (such as money, material, or services) that is given for something acquired or promised. This may be the appraised fair market value of the real property or may include protection of the real property against loss by fire, water, or other causes, or any mutually agreeable arrangement that does not conflict with governing statutory limitations.

core requirements -- Process oriented descriptions which describe the tasks needed to support Maintenance Engineering.

declaration of taking -- A pleading filed with a federal court of law in a real property condemnation proceeding whereby, on filing the pleading, together with deposit of estimated "just compensation" in the court, the real estate interest is vested in the government.

declaration of excess -- A narrative description of real property that is no longer required for foreseeable Air Force missions. The declaration contains an identification of the land, type of governmental real estate interest, facility inventory information, recommended disposal dates, re-use rights, and services, obligations, and outgrants outstanding (see AFI 32-9004).

direct scheduled work order -- Emergency or essential work generally not requiring detailed planning, also known as job orders.

direct digital control -- Any control system (HVAC, alarms, lighting, or otherwise) using entirely solid-state (digital) components.

District Engineer -- One of the several Division Engineers, US Army Corps of Engineers, who supervise the activities of certain District Engineers and are the intervening management level between the Chief of Engineers and District Engineers (e.g., US Army Engineer Division, North Atlantic, CENAD).

easement -- The right to use the land of another for a specified purpose. Usually, the owners of the land continue in possession and may use it as long as such use does not interfere with the purpose for which the easement was granted. An easement may be acquired for a specific term or in perpetuity. An easement differs from a license because: the privilege granted usually cannot be withdrawn during its term and it is considered to be a permanent interest in the property if the term exceeds one year.

emergency work -- Work that must be accomplished immediately.

eminent domain -- The right of the government to take private property for public use upon payment of just compensation.

Energy Conservation Investment Program (ECIP) -- A Military Construction (MILCON)-funded program primarily intended for accomplishing energy conservation retrofits of existing buildings. It includes construction of new, high-efficiency energy systems and modernization of existing systems. ECIP is an OSD centrally-managed program.

Energy Savings Performance Contract (ESPC) -- Contracting with a private sector company for completion of energy audits and installation of energy conservation projects. This provides a method to acquire energy conservation projects with no AF resources and without payment if savings do not result.

Energy Management Control System (EMCS) -- The civil engineer energy control system that historically manages heating, ventilation, and air conditioning (HVAC) systems. It differs from direct digital control in that it includes both solid state systems and the older pneumatic systems.

engineers -- Any engineer in Civil Engineer units to include the Base Civil Engineer, the Maintenance Engineer, program engineers, and project engineers.

environmental assessment -- A document, occurring early in the planning process, for evaluating the potential environmental impact of a proposed action. An assessment covers the same topical areas as an environmental impact statement (EIS), but with less detail. An assessment results in a decision that an EIS is necessary, or that the proposed action will have no significant effect, therefore, a finding of no significant impact (FONSI) can be made (AFI 32-7004).

environmental impact statement -- A detailed full-disclosure report which, pursuant to the National Environmental Policy Act (NEPA) of 1969, (42 U.S.C. 4321-4347), identifies and analyzes the anticipated environmental impact of a proposed Air Force action and discusses how the adverse effects of the proposal will be mitigated. It is prepared in two stages: a draft statement which is filed with the Environmental Protection Agency (EPA) and made available to the public for comment and a final statement which is revised to reflect comments made on the draft EIS (AFI 32-7004).

essential work -- Work that cannot wait for the next 1219 visit.

expanded clear zone easement -- The right to prohibit all uses of land, within 3,000 feet of the runway threshold and extending 1,000 to 1,500 feet on each side of the runway center line extended, that are incompatible with or could impede, aircraft operations. For additional guidance see AFI 32-7003.

facility investment metric (FIM) -- An Air Force facilities requirements identification program to assess facilities based on mission priority; used to develop funding priorities.

Federal Energy Management Program (FEMP) --	An OSD, centrally-managed program for projects less than $300K. Projects accomplish energy conservation retrofits of existing buildings or new construction plus energy audits, designs and metering programs. It includes construction of new, high-efficiency energy systems and modernization of existing systems.
fee ownership --	Title to real property belonging to a person or the government where full and unconditional ownership exists. Such ownership does not necessarily include mineral rights.
floodplain --	The 100-year floodplain is the lowland area adjoining inland and coastal waters, including flood prone areas of offshore islands that would be inundated by the base flood. The critical actions (or 500-year) floodplain is the area that would be inundated by a 500-year flood. (See AFI 32-7003.)
functional squadron --	Pre-1992 squadron structure, functionally oriented, it collocated like-functions and distribution portions of the missions and objectives to these functional shops.
general purpose space --	Space in buildings and associated land under the assignment authority of the General Services Administration (GSA) which GSA has found to be suitable for use by federal agencies, generally. The following categories of space are excluded: space in any building in a foreign country; space in any building on the grounds of a military or Coast Guard installation; space in airports; and special purpose space, as defined in GSA Federal Property Management Regulations (41 CFR 101, subpart 101-18.104-1).
grantee --	One to whom a grant is made.
grantor --	The person by whom a grant is made; a transferor of property.
GSA reimbursables --	These are special services, beyond the standard levels of service normally provided by GSA, for which the Air Force must reimburse GSA.
GSA rent --	Formerly called "standard level user charge (SLUC)," a rate charged by GSA for assigned space in government-owned or -leased property for which GSA has the assignment responsibility. The user charge approximates commercial charges for comparable space and services.
GSA space --	Space in buildings owned or leased by GSA and assigned to an Air Force or other federal government activity. This space includes land incidental to the use of the space.

hazardous substance --	This term is defined in CERCLA, 42 U.S.C. 9601 (14). For the purposes of this handbook it includes petroleum, petroleum products, oil, and lubricants (POL).
holding area --	A storage area for work order materials awaiting scheduling.
industrial facility --	Any Air Force -owned, -leased, or -controlled real property facility which is used by a contractor for the purpose of fulfilling government research, development, test, evaluation, production, maintenance, or modification contracts or for the storage of production machinery and equipment in support of such activity.
infiltration and inflow (I/I) --	Amount of water that seeps into a sanitary or storm sewer system, increasing the load on the fixed capacity pipes and treatment systems downstream.
ingrants --	Documents such as licenses, leases, permits, temporary easements, foreign base rights agreements, and treaties, under which the Department of the Air Force acquires an interest in, or control of, real property in less than fee ownership.
jurisdiction --	See legislative jurisdiction.
lease --	A conveyance of exclusive possessory interest in real property for a specified term in return for payment of rent or other consideration to the owner.
legislative jurisdiction--	This term, as used in this instruction in connection with a land area, means the power and authority of the federal government to legislate and to exercise executive and judicial powers within the area.
lessee --	One who possesses the right to occupy real property under a lease.
lessor --	One who holds title to, and conveys the right to use and occupy, a property under a lease.
license --	A privilege that can be withdrawn at will, to use or pass over a licensor's real property for a specific purpose (e.g., right-of-entry for survey and exploration, right-of-entry for construction, tree topping). Licenses merely confer a privilege to occupy real property at the sufferance of the owner. Licenses granted to other federal agencies are called permits.
life-cycle cost --	Primary criteria to be used for design (mandated by the Department of Defense); criteria of analyzing the cost over the life span of a component or system to ensure all costs are used (purchase prices, construction costs, maintainability, efficiency, reliability, etc.).

long-range plan --	Multi-year plan for projects to support a specific infrastructure element, originally termed “5-year Plan,” many bases and commands have converted to “6-year Plans” to match the two-year programming cycle.
maintainability --	Characteristic of a system describing the ease or frequency of maintenance, highly maintainable systems cost less to maintain.
maintenance engineer --	Chief of Maintenance Engineering.
MicroPaver --	Automated system used to inventory and analyze pavements.
mobilization --	The process by which the Armed Forces or part of them are brought to a state of readiness for war or other national emergency. This includes activating all or part of the Reserve Components as well as assembling and organizing personnel, supplies, and material.
National Capital Region (NCR) --	For purposes of this instruction only, a region encompassing the District of Columbia; Montgomery and Prince George's Counties in Maryland; Arlington and Fairfax, counties in Virginia; and the cities of Alexandria, Fairfax, and Falls Church in Virginia.
nonindustrial facility --	A unit of real property (other than DoD real property), including improvements. Nonindustrial facilities include hotels, motels, resort facilities, educational institutions, hospitals, office buildings, and other real property that can be used for military purposes. These type of facilities are not used or suitable for production or maintenance of materials, munitions, equipment, supplies, goods, and other products for military or civilian use ocean terminals.
non-MRL items --	Items not included in an established material requirements list (MRL). Most Contractor Operated Civil Engineer Supply Store (COCESS) contracts require the item be added to the MRL before the contractor provides the item.
non-pre-priced items (NPI) --	An item obtained for Air Force use by a COCESS contractor for which there was no prior solicited and agreed costs.
noun dictionary --	An item record list which includes item description, pricing history, demand data, and inventory data for each item loaded in CEMAS.
offer of gift (donation) --	Voluntary offer to transfer or convey to the government an interest in real property without payment or consideration of any kind by the government (AFI 51-601).

objective squadron --	Post-1992 squadron structure, objective-oriented, it purposes to collocate all functions necessary to support a mission or objective.
operations specialists --	The Air Force specialty created to support the scheduling and controlling of the Civil Engineer work forces; also known as work force manager, controller, triple-nickel, production controller, and scheduler.
option to purchase --	A contract whereby the owner of the real property gives the government the right to acquire an interest in the property at a stated price during a specified period of time. An offer to sell property, unsupported by any consideration, is not considered an option, and it may be withdrawn at anytime (10 U.S.C. 2677).
outgrants --	Documents such as leases, licenses, easements, joint-use agreements, and other agreements (including use agreements) under which the government's interest in, or control of, real property, as exercised through the Department of the Air Force, is modified by conferring rights therein to another government agency, nonfederal entity (such as a state or local government), or a private party (for such use as grazing livestock). (See AFI 32-9003.)
overhires --	Non-permanent employees hired to fulfill a specific purpose who does not fill an authorized position on the unit manning document, but is paid from civilian pay accounts and counts against the unit work-year ceiling
palace acquires--	Apprentice engineers hired by Air Force Personnel Center and managed on a central manning document; Major Commands and bases commit to a three-year training program and final job placement within the command
permit --	A nonpossessory right of exclusive or nonexclusive use of real property. When granted to a party other than a federal agency, it generally covers a one-time use and is called a "license." However, the term also is used to describe an authorization to use property under the jurisdiction of one government agency by another for a definite period. These two uses of the term must not be confused.
pre-priced items --	These are commonly used items where prices have been previously determined. This is basically what the COCESS contracts have been awarded on. The contractor agrees to provide particular items at a specified price.

pre-priced blanket purchase agreement --	Pre-negotiated BPAs established with vendors that identify specific items to be purchased at specific prices for a specific period of time. These are primarily used to reduce administrative cost and buyer time for purchasing high usage items such as CEMAS store stock.
preventative maintenance --	Recurring work performed to safeguard and/or extend the efficient and effective lifespan of real property, RPIE, or other equipment items.
program engineers --	Engineers of Maintenance Engineering, so termed because they manage infrastructure programs.
project engineers --	Engineers of the Engineering Flight, so termed because they manage projects (design and construction).
project --	As related to real estate acquisition activities, a project is a real property acquisition action, or related actions, at an Air Force installation to fulfill a known requirement. Related real property actions that constitute a complete project are processed simultaneously. (For example: The acquisition of land for an ammunition storage project usually involves the acquisition of fee ownership for the land area used to construct storage facilities and restrictive easements over an adjacent safety area.)
public domain --	Land originally acquired by the United States from foreign governments and which has never left United States ownership. It is administered by the Department of the Interior.
public lands --	Any land and interest in land owned by the United States within the states and administered by the Secretary of the Interior through the Bureau of Land Management without regard as to how the United States acquired ownership. The term excludes lands located on the outer Continental Shelf and lands held for the benefit of Indians, Aleuts, and Eskimos (43 U.S.C. 1702 (e) (see withdrawn land).
purchase request abstract --	CEMAS-generated LP requisition document used to request purchase of BCE items by the buyers.
purchase order --	A document authorizing a vendor to deliver BCE materials.
real property --	Lands, buildings, structures, utilities systems, improvements and appurtenances thereto. Includes equipment attached to and made part of buildings and structures (such as heating systems), but not movable equipment (such as plant equipment).

real estate directive --	A request to another federal agency (e.g., Office of the Chief of Engineers, US Army Corps of Engineers, Department of the Army or Naval Facilities Engineering Command, Department of the Navy or Bureau of Land Management, US Department of the Interior) to act on a real estate matter on behalf of the Air Force.
real estate --	See real property.
recurring work --	Routine, redundant, recurring work involving real property, real property installed equipment (RPIE), or systems and other equipment maintained by CE; scope and frequency is well known, locations are well established, materials are available or not required.
red-line drawings --	Marked-up drawings (typically blue-lines) indicating changes to facilities and as-built conditions, used to update as-built drawings.
release --	See CERCLA, 42 U.S.C. 9601 (22).
reliability --	Characteristic of a system that describes its anticipated lifespan and performance.
rent, nominal --	A rental consideration of a token amount in money or services. Generally, it involves a rental payment of $1.00 per year. Nominal rental also means a consideration completely unrelated to the actual or fair market value of the leased property.
request and authority to cite funds --	Base Contracting is provided a quarterly dollar target against which Base Civil Engineer local purchase items are obligated. The availability is certified by Accounting and Finance and the target amount is administered by Base Contracting. The Civil Engineer Funds Management Section should provide a complete AF Form 616, Fund Cite Authorization, to Base Contracting no later than the first working day of the quarter.
residue holding account --	An account for maintaining accountability of excess material after completing a work order.
restrictive safety easement --	The right to restrict the erection of habitable buildings, the congregation of people, or other activities within a specified safety clearance distance of munitions storage areas, armed aircraft and explosives-related facilities (see AFI 91-409).
retrocession --	The act of giving back to a state all or part of the federal legislative jurisdiction formerly enjoyed by the government.
right-of-way easement --	The right to pass over the land of another for a specific purpose. Such use could be for constructing a road, installing pipelines, pole lines, or telephone cables, etc.

right of entry --	The temporary right to enter on real property for a specified purpose without acquiring any estate or interest in it.
service contract --	A contract for nonpersonal services, executed under the Armed Services Procurement Act of 1947, where the contracting party agrees to perform some service for the Air Force and the Air Force agrees to pay for such service. In performing the service, the contractor may use real property in which he or she has an interest, even to the extent of permitting the Air Force to go on the property in a nonexclusive manner.
SLUC --	Standard Level Users Charge (see GSA rent).
stay-in-schools --	Temporarily hired employees who work a portion of the work week and attend school the rest of the week; are overhires and do not count against a manning document, pay comes from paid civilian pay and hours count against the unit work-year ceiling
space, special purpose --	Space in buildings not under assignment responsibility of the General Services Administration, including land incidental to the use thereof, that is fully or predominantly used for the special purposes of an agency having custody of such space and generally not suitable for use by other agencies. Examples of such space include computer centers, hospitals, laboratories, mints, penal institutions.
space, general purpose --	Space in buildings under assignment responsibility of the General Services Administration, including land incidental to the use thereof, that the GSA has determined to be suitable for use by federal agencies generally, **except**: space in buildings on installations of the Department of Defense or the Department of Transportation (US Coast Guard facilities) and any space designated by the GSA as special purpose space in 41 CFR 101, subchapter D, subpart 101-18.104-1.
stock record account number (SRAN) --	An accountable stock record account established for the Civil Engineer Material Acquisition Systems (CEMAS).
storage --	The holding of hazardous substances for a temporary period prior to the hazardous substances being either used, treated, transported, or disposed.
subordination agreement --	An agreement whereby the owner of a real estate interest (including subsurface oil, gas and mineral rights) agrees to suspend or limit the exercise of all or part of his or her ownership rights under specified terms and conditions (usually to avoid interference with governmental use of the surface or operations).

suspension agreement --	Suspension by lease of an individual's grazing or mineral rights in public land or state-owned lands.
urban centers --	These are the cities and standard metropolitan statistical areas (SMSA). General Services Administration is the sole leasing authority for obtaining general purpose space in these areas.
value (current, fair, and estimated) --	As used in this regulation, these terms mean current fair market value or current fair market rental value, as appropriate. Fair market value is the amount in cash, or on terms reasonably equivalent to cash, for which the property would be sold by an owner, willing but not obliged to sell, to a purchaser who desires, but is not obliged, to buy. Fair market rental value of a property is the amount that, in a competitive market, a well-informed and willing lessee would pay and that a well-informed lessor would accept for the use and occupancy of the property for a particular term.
vault --	Storage location of base as-built and Base Comprehensive Plan drawings, so termed because many bases originally stored these drawings in a vault for physical security.
wetlands --	Areas that are inundated by surface or ground water with a frequency sufficient to support, and under normal circumstances do or would support, a prevalence of vegetative or aquatic life that requires saturated or seasonally-saturated soil conditions for growth and reproduction. Wetlands generally include swamps, marshes, bogs and similar areas such as mud flats, natural ponds, potholes, river overflows, sloughs, and wet meadows. Wetlands may be, but are not necessarily, located in floodplains (AFI 32-7005).
withdrawn land --	Public land that has been set aside or designated for a specific public purpose, such as a national park, wildlife refuge, or national defense use. Withdrawal of public lands generally has the effect of segregating such land from lease, sale, settlement, or other dispositions under the public land laws.
work center(s) --	Civil Engineering Operations maintenance teams organized to maintain and repair base facilities and infrastructure systems. Depending on the installation, these Centers can be classified as either shops, zones or a combination of both.
work orders --	Work requiring detailed planning or capitalization of the real property records.

Attachment 2 Core Requirements

PROCESS ORIENTED DESCRIPTION
MAINTENANCE ENGINEERING

A1C.1. RECEIVES TRAINING:
A1C.1.1. RECEIVES CONTINGENCY TRAINING:
A1C.1.1.1. RECEIVES CATEGORY 1, CLASSROOM TRAINING.
A1C.1.1.2. RECEIVES CATEGORY 2, HANDS-ON TRAINING.

A1C.2. MANAGES REAL PROPERTY MAINTENANCE:
A1C.2.1. MANAGES INFRASTRUCTURE MAINTENANCE AND REPAIR PROGRAM:
A1C.2.1.1. MANAGES PAVEMENTS PROGRAM.
A1C.2.1.2. MANAGES ROOFING PROGRAM.
A1C.2.1.3. MANAGES WATER AND WASTEWATER PROGRAM.
A1C.2.1.4. MANAGES INDUSTRIAL WATER TREATMENT PROGRAM.
A1C.2.1.5. MANAGES ELECTRICAL DISTRIBUTION PROGRAM.
A1C.2.1.6. MANAGES AIRFIELD LIGHTING PROGRAM.
A1C.2.1.7. MANAGES CORROSION CONTROL PROGRAM.
A1C.2.1.8. MANAGES TRAFFIC PROGRAM.
A1C.2.1.9. MANAGES ENERGY PROGRAM.
A1C.2.1.10. MANAGES SHELTER PROGRAM.
A1C.2.1.11. MANAGES HVAC PROGRAM.
A1C.2.1.12. MANAGES WARRANTY PROGRAM.
A1C.2.2. REVIEWS DESIGN PROJECT:
A1C.2.2.1. REVIEWS IN-HOUSE DESIGNED PROJECT.
A1C.2.2.2. REVIEWS ARCHITECTURAL-ENGINEERING DESIGNED PROJECT.
A1C.2.2.3. REVIEWS MILITARY CONSTRUCTION DESIGNED PROJECT.
A1C.2.3. PERFORMS WORK ANALYSIS:
A1C.2.3.1. DEVELOPS PERFORMANCE STANDARD.
A1C.2.3.2. DEVELOPS AND MEASURES PRODUCTIVITY INDICATOR.
A1C.2.3.3. REVIEWS ZONE WORKLOAD, MANPOWER BALANCE, AND SKILLS MIX.
A1C.2.3.4. PERFORMS ECONOMIC ANALYSIS.
A1C.2.3.5. PERFORMS OPERATIONS STAFF WORK.
A1C.2.4. MANAGES CONTRACT:
A1C.2.4.1. MANAGES RECURRING SERVICE CONTRACT:
A1C.2.4.1.1. DEVELOPS AND MODIFIES CONTRACT PACKAGE.
A1C.2.4.1.2. NEGOTIATES CONTRACT.
A1C.2.4.1.3. INSPECTS CONTRACT.
A1C.2.4.1.4. PREPARES REPORT.
A1C.2.4.2. MANAGES NON-RECURRING SERVICE CONTRACT:
A1C.2.4.2.1. DEVELOPS AND MODIFIES CONTRACT PACKAGE.
A1C.2.4.2.2. NEGOTIATES CONTRACT.
A1C.2.4.2.3. INSPECTS CONTRACT.
A1C.2.4.2.4. PREPARES REPORT.

A1C.2.4.3. MANAGES UTILITY CONTRACT:
A1C.2.4.3.1. DEVELOPS AND MODIFIES CONTRACT PACKAGE.
A1C.2.4.3.2. NEGOTIATES CONTRACT AND MODIFIED PACKAGE.
A1C.2.4.3.3. MAINTAINS BROCHURE.
A1C.2.4.3.4. MANAGES UTILITY RESALE AGREEMENT.
A1C.2.4.3.5. CONDUCTS BASE UTILITY SERVICE MEETING.
A1C.2.5. PROVIDES NON-DESIGN DRAFTING SUPPORT:
A1C.2.5.1. UPDATES AS-BUILT DRAWING.
A1C.2.5.2. MAINTAINS TABS FOR BASE COMPREHENSIVE PLAN (BCP).
A1C.2.5.3. PERFORMS NON-DESIGN REPRODUCTION.
A1C.2.5.4. REPAIRS AND MAINTAINS DRAWING.

Attachment 3 Consolidated Facility Infrastructure Investment Program

Attachment 3 is a sample of the consolidated infrastructure program package. It is a modified copy of an actual package used at Hill AFB to support their infrastructure program.

(not shown in this sample)
ACC/CEO has also developed Infrastructure Standards and Assessment Tools to provide bases a process to perform subjective professional engineering assessments of their systems.

Infrastructure program packages should now incorporate terms and standards consistent with the Facility Investment Metric (FIM) program.

SAMPLE
AIR FORCE BASE
FACILITY INFRASTRUCTURE INVESTMENT PROGRAM
00TH CIVIL ENGINEER SQUADRON

FY 199X

Preface

The 00th Wing at Sample Air Force Base is committed to investing in its infrastructure. The base infrastructure is critical to supporting the missions of the 00th Wing, the Tenant Units, and the other diverse missions of Sample Air Force Base. The investment strategy presented here will enable us to increase infrastructure reliability to 85% by the year 200X. Infrastructure reliability directly supports our ability to compete successfully for Air Force and Department of Defense workloads.

The Strategy:

1) Identify requirements
2) Prioritize the need
3) Establish program avenue
4) Devise strategy of accomplishment

This booklet presents our facility infrastructure investment program.

Table of Contents

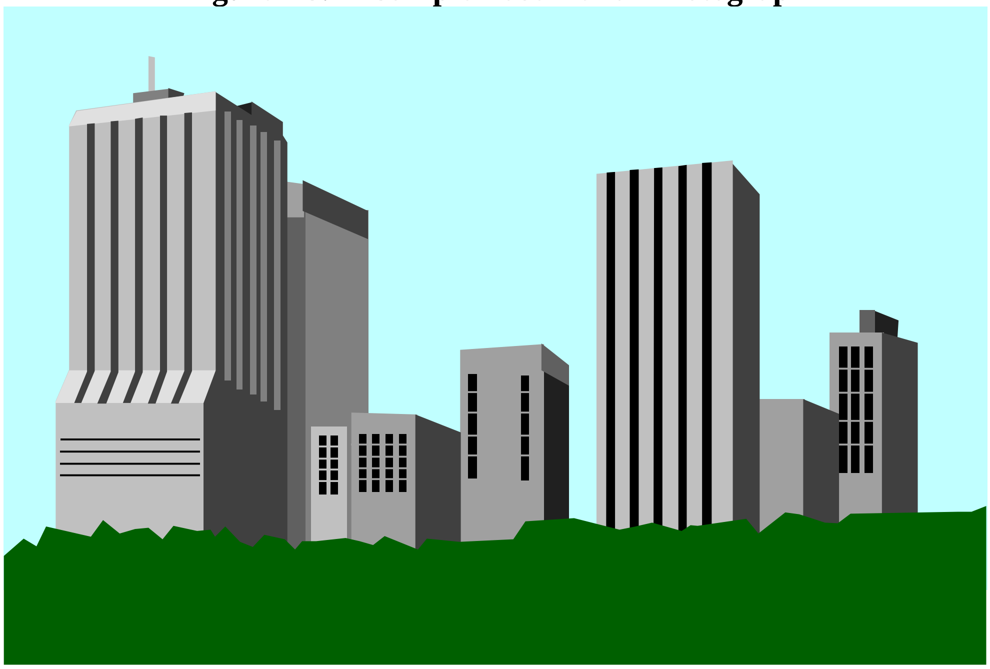
SAMPLE AIR FORCE BASE
INFRASTRUCTURE STATISTICS
(Base Proper)

Land Area	6,698 Acres
Buildings	1,364 Facilities 13,862,097 Square Feet
Family Housing	568 Buildings 1,145 Units
Max. Daily Energy Usage	7 Trillion British Thermal Units (BTU) per day
Utilities	1,038,063 Linear Feet Electric Lines 232,300 Linear Feet Gas Lines 1,053,300 Linear Feet Water Lines 447,400 Linear Feet Sanitary Lines 350,400 Linear Feet Storm Lines
Airfield Pavements	225,000 Sq. Yards of Runway 262,000 Sq. Yards of Taxiway 606,000 Sq. Yards of Aprons 349,279 Sq. Yards of Paved Shoulder
Roads	148 Miles
Railroad Tracks	29 Miles
Total Investment Cost	$3,561,274,000
Work Force	4,737 Military 10,337 Civilian

Infrastructure Defined

Facility Infrastructure is defined as "*all existing buildings and other base utilities and pavements used for support of the existing mission and normal growth of the base*." As the custodian, the Base Civil Engineer is responsible for maintaining and repairing the facility infrastructure, including new construction for the normal revitalization of existing assets. This definition excludes new construction or any renovation needed to support a new or expanded mission including specialized or test facilities would not be included in our definition of infrastructure and work associated with an industrial process or test. The facility infrastructure is divided into seven systems which are described on the following pages.

Figure A3.1 - Sample Base Aerial Photograph



(insert here an aerial photo of your base or a quality picture of a command facility; for example, the wing headquarters building)

Note: To serve the level of the audience, many infrastructure programs normally managed separately have been rolled together.

Infrastructure Defined (cont'd)

I. Building System: This system covers the entire building envelope and its interior within a "five-foot-mark" from outside the building. The building envelope includes the foundation and structural system, weatherproofing (exterior siding, painting, insulation, and roofing) and all exterior architectural treatment. The interior features include ingress and egress layout, interior architectural treatment, structural and comprehensive interior design, floor covering and interior painting. Temperature systems are not included.

Figure A3.2 - Sample Base Showcase Facility

(insert here a real picture of a showcase facility on your base)

Infrastructure Defined (cont'd)

II. Pavements and Traffic System: This system covers all pavements and traffic facilities. This includes all airfield pavements and all road and parking lot pavements in addition to traffic control devices, bridges, railroads, etc. This infrastructure system also includes all sitework, such as demolition, clearing, rough and finish grading, landscaping, fencing, and revetments.

Figure A3.3 - Sample Base Main Access Road

(insert here a photo of a main road on base -
preferably showing traffic control devices and/or a view of the runway)

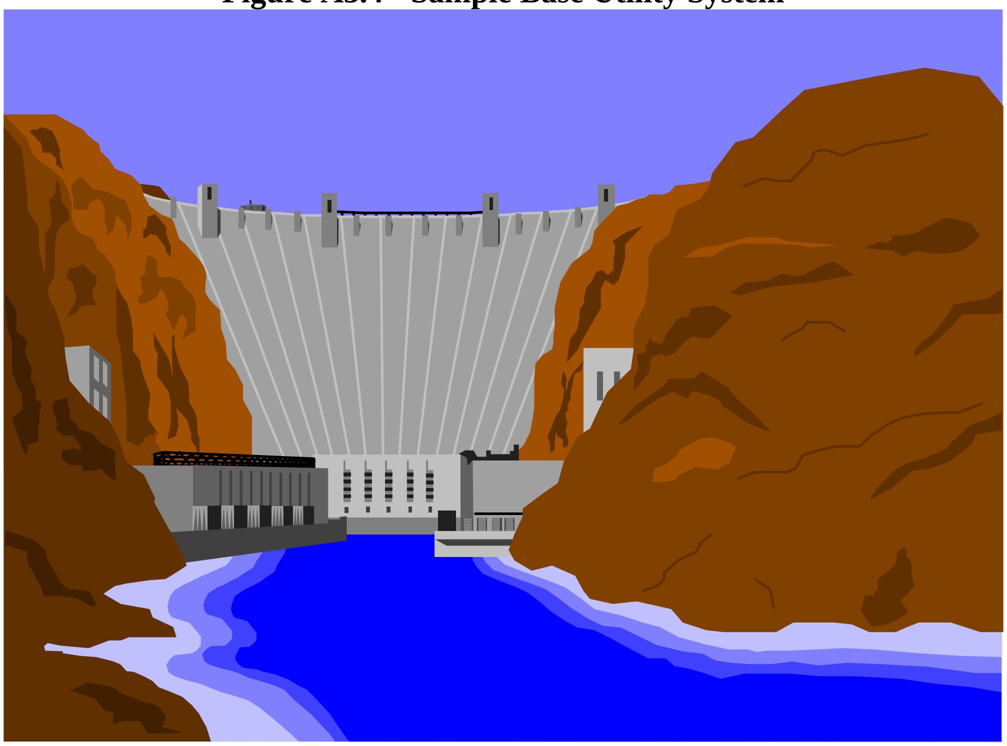
Infrastructure Defined (cont'd)

III. Utilities Systems: These systems cover most exterior utilities including:

- domestic water collection, treatment, storage and distribution
- storm water collection and disposal
- sanitary and industrial waste collection, storage, treatment and disposal
- natural gas storage and distribution
- compressed air distribution
- liquid fuels storage and distribution

up to the "five-foot mark" on all facilities.

Figure A3.4 - Sample Base Utility System

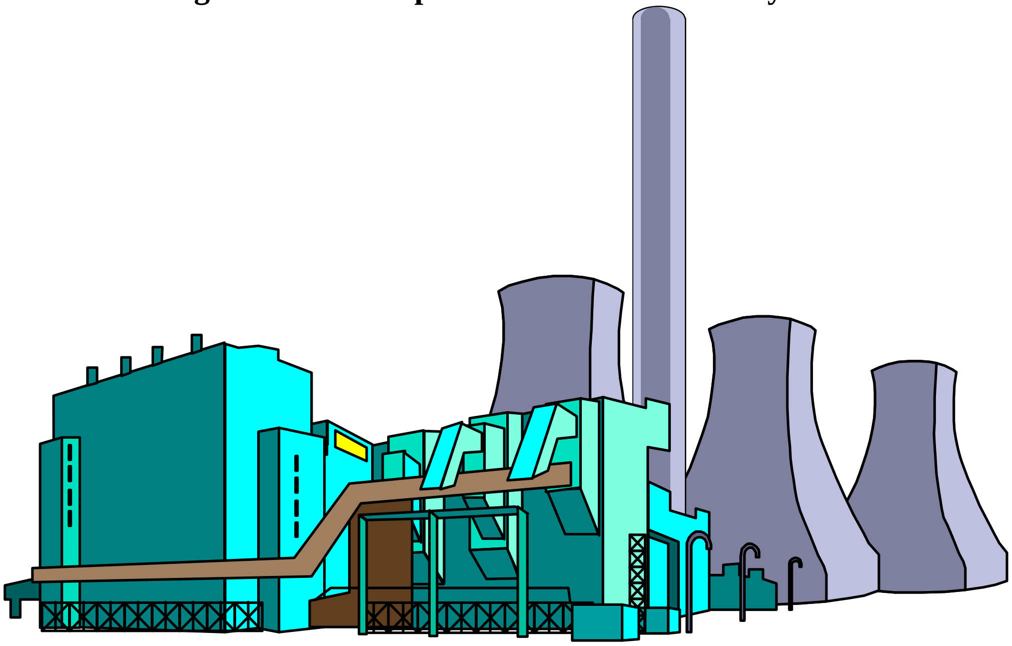


(insert here a photo a highly visible utility system component)

Infrastructure Defined (cont'd)

IV. Power Systems: These systems cover all power generation and electrical distribution systems up to the "five-foot-mark" on all facilities. It includes substations, both overhead and underground voltage systems, transformers, and the building service. Street lighting, visual air navigation facilities for aircraft and aircraft arresting systems are also included in this system.

Figure A3.5 - Sample Base Power Plant or System

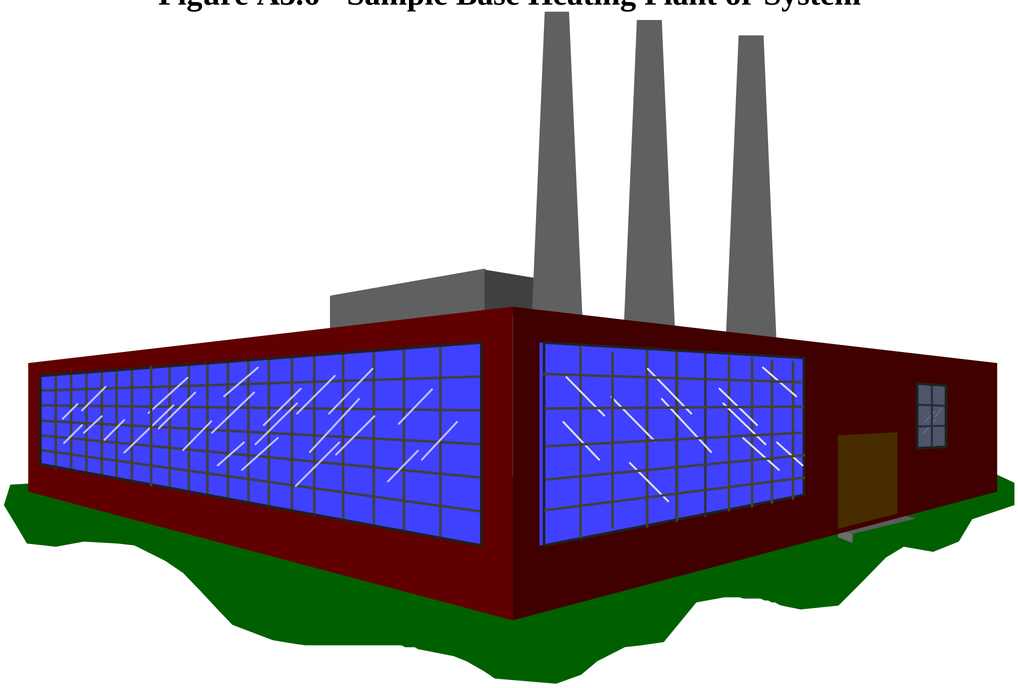


(insert here a photo of a high-visibility power plant, substation, or system)

Infrastructure Defined (cont'd)

V. Heating, Ventilation and Air Conditioning (HVAC) Systems: These systems cover all interior and exterior components. Heating systems include generation and distribution of steam and high temperature water to each facility and the connected interior systems. Air conditioning includes centralized chilled water plants and distribution systems, dedicated chilled water systems, packaged units, heat pumps, evaporative cooling units, refrigeration units, etc. HVAC also includes all solar and ventilation systems.

Figure A3.6 - Sample Base Heating Plant or System



(insert here a photo of a high-visibility plant or system -
a photo of a steam plant with elevated steam lines will answer an oft-asked question:
what are those things?)

Infrastructure Defined (cont'd)

VI. Energy Management Systems: This program covers all systems supporting the base energy management and reduction requirements and include and electrical and mechanical control systems in addition to other infrastructure projects created to reduce base energy costs. Electrical control systems consist of metering systems, interior electrical systems, security systems, and cathodic protection systems. Mechanical control systems include air and water pollution devices, mechanized systems (elevators, escalators, lifts, etc.), temperature and humidity systems, energy management and control systems/direct digital control (EMCS/DDC) systems.

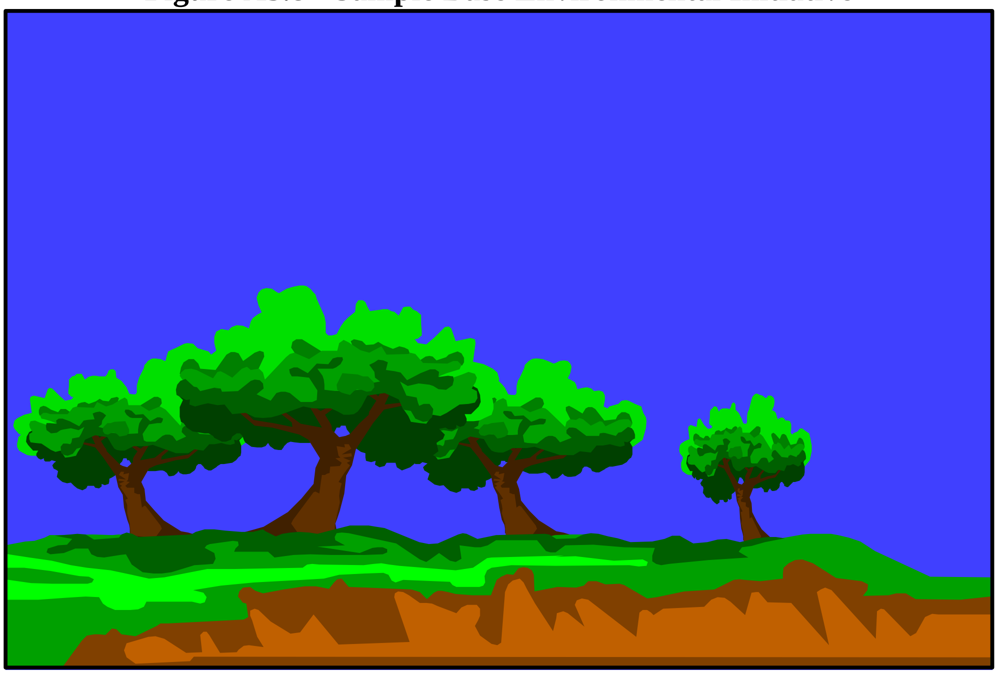
Figure A3.7 - Sample Base Energy Initiative

(insert here a photo of a high-visibility energy initiative)

Infrastructure Defined (cont'd)

VII. The Environment and Environmental Support Systems: This program recognizes the support necessary to ensure safe working and living environments for our people. In addition, the program supports all efforts and systems necessary to safeguard the base, community, state, and national environment.

Figure A3.8 - Sample Base Environmental Initiative



(insert here a photo of a high-visibility environmental initiative)

The Infrastructure Challenge

The challenge we face is to preserve and protect the over $3.5 billion investment in facility infrastructure that supports the critical Sample AFB missions with dramatically decreased funding levels. With the majority of the facilities on base over 35 years in age, we need to ensure that the maintenance and repair of these facilities is not reduced to the point that we merely react to failures and let our facility infrastructure slowly degrade.

As reliable facility infrastructure is critical to accomplishing the mission, a minimum annual investment in infrastructure programs is necessary to satisfactorily improve the current infrastructure and maintain optimum reliability. Using a goal of 1.5 percent of plant replacement value, Sample Air Force Base would require a minimum investment of $53.4 million per year.

00 Civil Engineer Squadron's challenge and obligation to the Wing is to identify the work that needs to be done, prioritize the work smartly based on mission need and infrastructure condition, and then, most importantly, seek the funding to accomplish the work.

Infrastructure Requirements

Sample AFB currently needs $267 million over the next five years to achieve our goal of investing 1.5% of the plant replacement value. Through customer inputs, the Facility Investment Metric (FIM), CE engineer and craftsmen technical inputs, and facility surveys, we have identified and validated $350 million in requirements. Individual requirements are correlated with the total investment needs in Figure A-3.10 below:

Figure A3.9 - Percentage of the FY 9X $53.3 Million Program

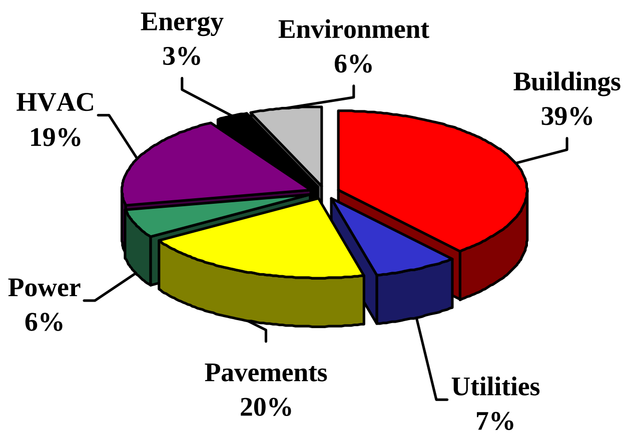
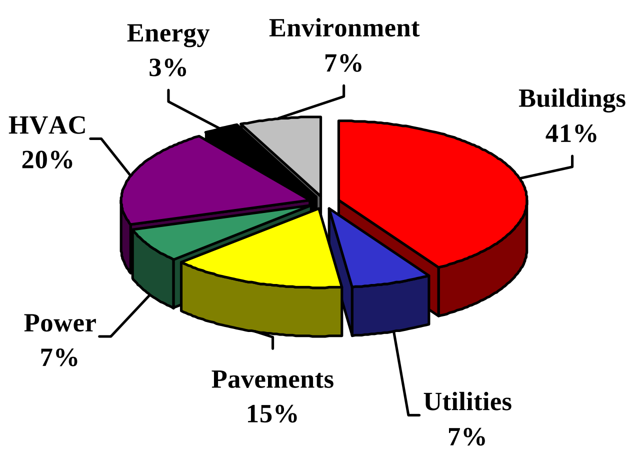


Figure A3.10 - Percentage of $267 Million Program (5 Year Plan)



Infrastructure Evaluation

Sample AFB uses the Air Force Civil Engineer Condition Standards to evaluate the bases infrastructure systems. These standard ratings range from “0” for a failed condition to “10" for a system requiring only routine maintenance. A color of red, yellow, or green is selected to coincide with the rating system. These ratings are used within funding programs to aide in prioritize the funding. Our ratings for the end of FY 9X were:

	Mission (60% of rating)	Condition (40% of rating)		Consolidated (100%)	
Buildings	7.6	8.1	=	7.8	●
Utilities	8.0	6.1	=	7.24	⊗
Pavements	7.3	7.8	=	7.5	●
Power	8.8	5.3	=	7.4	⊗
HVAC	6.8	4.5	=	5.9	❍
Energy	8.3	5.3	=	7.1	⊗
Environment (use ECAMP)	8.5	8.5	=	8.5	●

Index = 65.1% Wing Goal: 85%

●	-	(green) System good	> 7.5
⊗	-	(yellow) System moderately defective 7.5> rating	> 6.0
❍	-	(red) System will impact mission	< 6.0

Funding Strategy

To merely recognize that DoD as a whole does not invest as much funds as other agencies is not enough. In an ever shrinking funding environment, we must have a funding strategy in order to ensure that funds for infrastructure maintenance and repair are available when needed.

The strategy of Sample AFB is twofold. First, projects must be correctly programmed through the proper funding avenue. Secondly, we must relate the project costs to the customer in a timely manner to allow for proper budgeting processes.

FIVE YEAR FUNDING TARGET

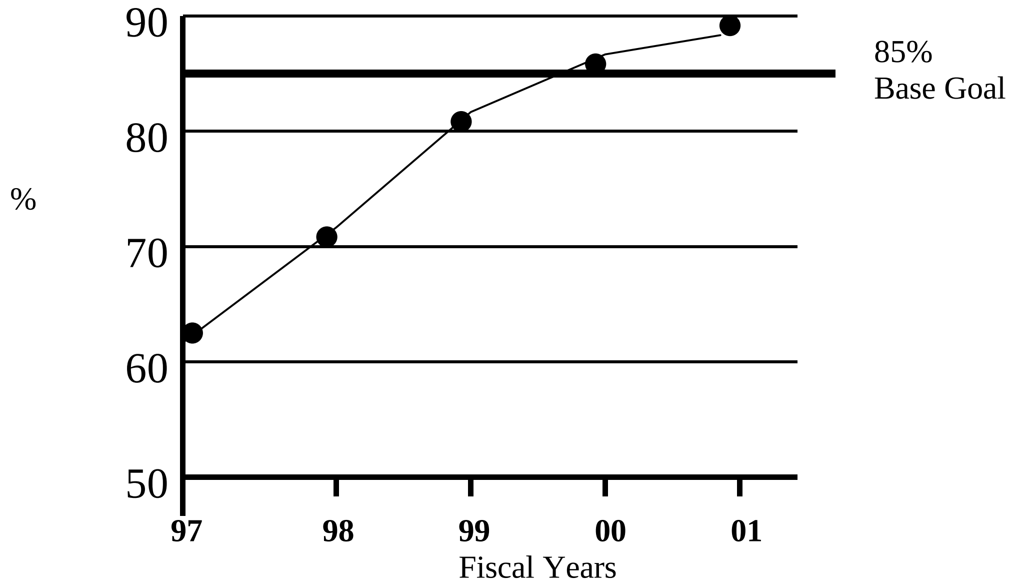
($M)

TOTAL	MILCON	MFH	ECP	MED	TEN	O&M	DERA
$267	$91	$33	$8	$11	$17	$88	$19

Strategy Summary

The goal of the Sample AFB infrastructure program is to support customers with reliable infrastructure. The strategy is to adequately fund systematic improvements to reach an overall 85% reliability by the year 2000. By following our five-year infrastructure program, Sample AFB will meet the 85% goal in 2000 as shown below.

Figure A3.11 - Sample Base Strategic Summary



Infrastructure Projects
FY 9X - FY 0X

The remaining pages of this booklet provide a listing of all infrastructure projects currently identified. These projects are broken into their respective systems, funding sources and funding amounts.

Figure A3.12 - Sample Base Five Year Plan

	SAMPLE AFB 5 YEAR PLAN						
	Fiscal Year 199X Program						
PROJECT	**TITLE**	**SYS**	**MIS**	**COND**	**CNSD**	**PGM**	**COST(000)**
944016	Building Demolish Ph II MFH	B	1	1	1	MFH	854.1
940156	Repair Dormatory Roof	B	3	3	3	O&M	30.0
940209	Repair Asphalt Shingle Roofs	B	3	3	3	O&M	250.0
940223	Repair Roof, Bays 7B/C/E/9A/B/C Bldg 800	B	3	3	3	TEN	680.0
940224	Replace Roof, Bldg 810	B	3	3	3	TEN	513.2
940225	Replace Roof Bays 7A/D & 9D	B	3	3	3	O&M	378.0
940148	Replace Metal Roofs	B	4	2	3.2	O&M	500.0
941054	Quartz Flooring, Bldg 39E	B	4	4	4	TEN	20.1
920146	Alter Building 1151 for Vehicles	B	4	5	4.4	O&M	144.7
940107	Replace Doors/Locks/Hardware	B	4	5	4.4	O&M	104.9
940121	Replace Dormatory Carpet	B	4	5	4.4	O&M	73.0
940145	Paint Exterior Base Buildings	B	4	5	4.4	O&M	100.0
941017	Enclose Weapon Discharge Box	B	4	5	4.4	O&M	3.0
870191	Q. of Life - Install Entry Covers @ 1200 Zone	B	4	5	4.4	O&M	190.0
944004	Repair Carports MFH D/E	B	5	5	5	MFH	371.1
944023	Paint Exteriors MFH A	B	5	5	5	MFH	4.6
950105	Repair Building 1218	B	5	5	5	O&M	34.1
950137	Emergency Roof Repair 1200 Zone Buildings	B	5	5	5	O&M	17.6
950048	Repair Beryllium Room, Building 507	B	5	5	5	O&M	3.8
	......................and other Building Projects . . .						
	FY 9X Requirement for Building Systems		7.6	8.1	7.8		20,952.6

PROJECT #	TITLE	SYS	MIS	COND	CNSD	PGM	COST(000)
940015	Replace Natural Gas Lines, Flightline Area	U	4	4	4	O&M	588.8
940116	Replace Natural Gas Lines, Northwest Sector	U	4	4	4	O&M	924.7
940791	Upgrade Underground Heat Oil Storage Tanks	U	4	4	4	ECP	156.3
940792	Replace Underground Heat Oil Storage Tanks	U	4	4	4	ECP	640.2
890641	Replace Sanitary Sewers, West Branch	U	7	3	5.4	O&M	450.1
910162	Overhaul Sewage Lift Station, South Branch	U	7	3	5.4	O&M	75.8
	.......................and other Utility Projects . . .						
	FY 9X Requirement for Utility Systems		8	6.1	7.24		3,510.0
PROJECT #	**TITLE**	**SYS**	**MIS**	**COND**	**CNSD**	**PGM**	**COST(000)**
942070	Repair Pavements 1600 Zone	G	4	4	4	O&M	212.4
944014	Paint Fences - MFH A/B	G	4	4	4	MFH	65.0
950123	Repair Pavement/Berms 1600 Zone	G	4	4	4	O&M	167.3
950141	Replace PCC Slabs A2B	G	4	4	4	O&M	102.5
	.......................and other Pavements Projects . . .						
	FY 9X Requirement for Pavements Systems		7.3	7.8	7.5		10,432.0
PROJECT #	**TITLE**	**SYS**	**MIS**	**COND**	**CNSD**	**PGM**	**COST(000)**
940119	Q. of Life - Improve walkway lighting	P	3	8	5	O&M	174.8
941062	Replace Lights/Poles MFH D/E	P	5	5	5	MFH	137.3
950132	Replace Failed Aircraft Arresting System	P	8	2	5.6	O&M	200.0
950133	Replace BAK-9 Aircraft Arresting System	P	8	4	6.4	O&M	199.0
950117	Repair Electrical Distribution Lines - B Circ.	P	8	8	8	O&M	134.1
	.......................and other Power Projects . . .						
	FY 9X Requirement for Power Systems		8.8	5.3	7.4		3,392.0
PROJECT #	**TITLE**	**SYS**	**MIS**	**COND**	**CNSD**	**PGM**	**COST(000)**
942076	Repair Heat System at 1300 Zone Igloos	H	3	3	3	TEN	144.8
930178	Repair Steam/Condensate Lines, 419 Area	H	4	4	4	O&M	318.7
940151	Replace Boilers/Tanks/Roof, Building 1703	H	4	4	4	O&M	269.3
950009	Repair Base Steam/Condensate Lines	H	4	4	4	O&M	291.3
950143	Replace HVAC, Bldg 1269	H	4	4	4	O&M	200.0
	.......................and other HVAC Projects . . .						
	FY 9X Requirement for HVAC Systems		6.8	4.5	5.88		10,134.0
PROJECT #	**TITLE**	**SYS**	**MIS**	**COND**	**CNSD**	**PGM**	**COST(000)**
940711	Replace HVAC, Bldg 5, BayU	E	5	5	5	ECP	76.6
950675	Insulate Metal Bldg 431, Dryvit	E	8	3	6	O&M	150.3
940501	Install Electrical Meters in Tenant Facilities	E	7	5	6.2	TEN	135.4
	.......................and other Energy Projects . . .						
	FY 9X Requirement for Energy Systems		8.3	5.3	7.1		1,532.3

PROJECT #	TITLE	SYS	MIS	COND	CNSD	PGM	COST(000)
930193	Repair Transite Roof, 1200 Zone	V	6	4	5.2	O&M	770.0
932042	Repair Transite Roof, Bldg 1208	V	7	4	5.8	O&M	70.0
960740	Asbestos Removal	V	7	5	6.2	O&M	200.0
922025	Install Sound Attenuation, Bldg 1301	V	6	7	6.4	O&M	23.6
950713	Replace U/G Storage Tanks w/ Above Ground	V	8	6	7.2	DERA	600.0
	.......................and other Environmental Projects . . .						
	FY 9X Requirement for Environmental Systems		8.5	8.5	8.5		3,321.8
	Total Requirements for FY 9X						53,274.7
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	Fiscal Year 199X +1 Program						
PROJECT #	**TITLE**	**SYS**	**MIS**	**COND**	**CNSD**	**PGM**	**COST(000)**
950321	Repair Room 107, Building 507	A	6	6	6	O&M	52.5
	. . . . . And So On						

Epilogue

The 00th Civil Engineer Squadron at Sample Air Force Base is committed to investing in its facility infrastructure. Reliable infrastructure will enable the wing and tenant missions to succeed. Investment requirements through FY 200X have been identified. Continuous commander, user, and civil engineer team effort will be needed to ensure that all requirements continue to be identified in a timely manner, properly prioritized, correctly programmed and adequately funded. Our strategy is to preserve and protect the facility infrastructure at Sample Air Force Base to achieve the command goal to operate quality installations.